



Proposal for Actuarial Audit of the Public Employees Retirement System of Ohio

Submitted to the Ohio Retirement Study Council by:

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July 11, 2014

Ms. Bethany Rhodes, Director
Ohio Retirement Study Council
88 East Broad Street, Suite 1175
Columbus, OH 43215

Re: RFP for Actuarial Audit of the Public Employees Retirement System of Ohio

Dear Ms. Rhodes:

On behalf of Milliman, Inc., we are pleased to present this proposal to provide an actuarial audit of the December 31, 2013 actuarial reports prepared by Gabriel Roeder Smith & Company ("GRS") of the Public Employees Retirement System of Ohio. Milliman has a long history of serving large and complex public retirement systems. We are well-qualified to perform the services requested.

We have over 65 years of experience providing actuarial services to large public employee retirement systems. Our work as consulting actuaries for many other public employee retirement systems provides a broad range of valuable experience to assist in this project.

We will assign consultants to this project who are nationally recognized experts in the public sector and who have extensive experience providing actuarial audit services to large state-wide public employee retirement systems.

This proposal follows the format set forth in the RFP and describes our firm, our approach to providing these services, our people and our proposed fees.

Full contact information for the lead consultant of the project team is:

Glenn D. Bowen, FSA, EA, MAAA
Milliman, Inc.
1550 Liberty Ridge Drive Suite 200
Wayne, PA 19087-5572
610-975-8051
610-995-9321 (fax)
glenn.bowen@milliman.com

We are authorized to contractually bind Milliman.

We would be happy to discuss any aspect of this proposal in more detail should you have any questions upon review. Thank you for the opportunity to present Milliman's capabilities to the System and we look forward to working with you.

Sincerely,



Glenn D. Bowen, FSA, EA, MAAA



Katherine A. Warren, FSA, EA, MAAA

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Section 1

Proposal Summary

We understand the Ohio Retirement Study Council, "ORSC", wishes to retain a consulting actuary to complete an actuarial audit of the Public Employees' Retirement System of Ohio, "PERS". We propose a team of highly qualified actuaries with extensive experience providing actuarial services to large state-wide public employee retirement systems, and actuarial audits in particular.

We understand that the actuarial audit is to include the following:

1. **Data Validity** - We will test the data provided to the PERS actuary to determine its appropriateness.
2. **Actuarial Valuation Method and Procedures** – An actuary must complete the following major steps to prepare an actuarial valuation as of a given date:
 - a. identify the plan provisions,
 - b. gather necessary data,
 - c. select appropriate actuarial assumptions,
 - d. select an asset valuation method,
 - e. consider the interrelationship between procedures, assumptions and plan provisions, and between the methods used to measure assets and obligations,
 - f. apply an actuarial cost method, and,
 - g. determine the appropriate contribution for the plan year.

We will review the actuary's methods and procedures for each of these steps based on guidance provided in relevant Actuarial Standards of Practice (ASOPs).

3. **Actuarial Valuation Assumptions** - We will perform a thorough review of the January 1, 2006 to December 31, 2010 actuarial experience review and provide our opinion regarding the appropriateness of the analyses completed, as well as the appropriateness of the conclusions reached on:
 - a. demographic assumptions (turnover, retirement, mortality, etc.) in light of the guidance in ASOP 35, and,
 - b. economic assumptions (interest rate, salary increases, COLA, etc.) in light of the guidance in ASOP 27.

We will also review the assumptions used to measure the retiree health care benefit obligations and assess whether they are consistent with the guidance in ASOP 6, which covers the measurement of group retiree benefit obligations.

4. **Parallel Valuation** - We will attempt to replicate the valuation results presented in the December 31, 2013 PERS annual pension valuation and the December 31, 2013 annual retiree health care actuarial valuation using Milliman's valuation software. We will report to ORSC the figures produced by Milliman's replication and compare them to the results shown in the PERS valuation reports.
5. **Review of Health Care** - We will review PERS' policy for determining retiree contributions for healthcare benefits since 2000. After reviewing the policy, we would also independently verify the January 2014 monthly contributions for a sample of retirees, disabled retirees, and surviving spouses as of December 31, 2013. Our report would include the results of our review of the policy and the independent verification of the implementation of the policy.

In the event we recommend any adjustments to existing assumptions or methodologies to more accurately reflect the present and future assets, liabilities, and costs of PERS, we will provide a detailed explanation for why we believe such modifications would improve the valuation process and indicate the general effect on PERS's condition if those recommendation(s) are adopted.

All of our findings, including any recommendations, will be set forth in a full report including an executive summary with a high-level presentation of the key findings, and a detailed narrative that may be of use to the ORSC staff, System staff and/or their actuary.

In addition to providing our findings in a final written report we will present our findings to the ORSC and the PERS Board. The consulting team will remain available to the ORSC and PERS for follow-up questions after the entire audit project has been completed.

Section 2

Project Team Capabilities and Experience

The Proposed Project Team to audit the PERS of Ohio is drawn from the Pension Practice in Milliman's Philadelphia office, which has extensive experience providing actuarial consulting services to large state-wide public employee retirement systems.

Our experience in serving large systems of comparable complexity to PERS includes the following current clients:

- Since 1996, we have served as retained consulting actuary to the Teachers' Pension and Annuity Fund of New Jersey (TPAF), which provides pension and health insurance benefits to retired teachers. Our services have included preparing the annual actuarial valuation, triennial experience studies, 30-year projection models of contributions and funded status that the client uses to forecast future alternative scenarios regarding contributions, investment results, and possible plan modifications. TPAF has 151,000 active members, 92,000 retirees and beneficiaries, and \$27 billion of assets.
- Since 2007 we have served as retained consulting actuary to the Teachers' Retirement System of Puerto Rico. This system has 42,000 active members, 38,000 retirees and beneficiaries, and \$2 billion of assets.
- Since 2009 we have served as retained consulting actuary to the Government Employees' Retirement System of Puerto Rico. This system has 126,000 active members, 124,000 retirees and beneficiaries, and \$1 billion of assets.
- Since 1986, we have served the Pennsylvania Public Employee Retirement Commission. Our services primarily include providing actuarial cost notes on proposed legislation affecting the 2 largest state-wide systems in Pennsylvania – the Public School Employees' Retirement System and the State Employees' Retirement System.
- Since 2006 we have served the Pennsylvania Secretary of the Budget regarding the long-term contributions to the Public School Employees' Retirement System and the State Employees' Retirement System under various alternative scenarios.
- Since 2012 we have served the City of Detroit regarding the General Retirement System and the Police and Fire Retirement System.

In addition, from 1989 to 2013, we served the Ohio Retirement Study Council in meeting their oversight responsibilities regarding the five state-wide Ohio Retirement Systems.

Within the past 10 years we have completed one-time special projects for the following clients:

- In 2012 we audited the United Nations Joint Staff Pension Fund. It has \$37 billion in assets and over 179,000 members.
- In 2009 we audited the State Teachers Retirement System of Ohio. It has \$67 billion of assets and over 315,000 members.
- In 2006 and 2001 we audited the Pennsylvania Public School Employees' Retirement System, which has \$51 billion of assets and 589,000 members.
- In 2005 we audited the Pennsylvania State Employees' Retirement System, which has \$24 billion of assets and 229,000 members.

Other Milliman offices also do extensive work for large state-wide public employee retirement systems. More information about Milliman's public sector clients and other actuarial audits appears in Appendix D.

Section 3

Client References

The following is a list of large public employee retirement systems for which the Pension Practice in Milliman's Philadelphia office completed actuarial valuations or audits. We have also provided names, addresses and phone numbers of individuals who may be contacted for reference purposes.

New Jersey Teachers' Pension and Annuity Fund – consulting actuary since 1996

Mr. John Megariotis
Assistant Director, Finance
State of New Jersey
Department of the Treasury
Division of Pensions & Benefits – CN295
Trenton, NJ 08625-0295
John.Megariotis@treas.state.nj.us
609-292-3674

Ohio State Teachers Retirement System – 2009 Actuarial Audit

Mr. Michael J. Nehf
Executive Director
State Teachers Retirement System of Ohio
275 East Broad Street
Columbus, OH 43215-3771
nehfm@strsoh.org
614-227-4090

Puerto Rico Government Puerto Rico Government Employees and Judiciary Retirement System Administration – consulting actuary since 2009

Francisco del Castillo Orozco, Interim Administrator
437 Ponce de León Avenue
Hato Rey, PR 00917-3711
fdelcastillo@retiro.pr.gov
787-777-1662

Puerto Rico Teachers Retirement System – consulting actuary since 2007

Wanda Santiago Lopez, Interim Executive Director
235 Arterial Hostos Avenue, 8th Floor
San Juan, PR 00918
wasantiago@srm.pr.gov
787-777-1414 Ext 2237 until August 14, Ext 2800 effective August 15

United Nations Office of Internal Oversight Services – 2012 Actuarial Audit of the United Nations Joint Staff Pension Fund

Ms. Carmen Vierula, Chief, New York Audit Service
Internal Audit Division, OIOS
United Nations
380 Madison Avenue, Room M-10061
New York, New York 10017
vierula@un.org
917-367-2167

Section 4

Staff Qualifications

The lead consultant and supervising actuary will be Glenn D. Bowen. Glenn is a Principal of Milliman, a Fellow of the Society of Actuaries, an Enrolled Actuary and a Member of the American Academy of Actuaries and has extensive experience preparing actuarial valuations for retirement programs. He currently manages the retirement consulting practice in Milliman's Philadelphia office. His experience with public retirement systems includes work for:

- the City of Detroit,
- the Metropolitan Transit Authority of New York,
- the New Jersey Teachers Pension and Annuity Fund,
- the New York City Office of Management and Budget,
- the New York State Division of Budget,
- the Ohio Retirement Study Council,
- the Pennsylvania Legislative Budget and Finance Committee,
- the Pennsylvania Secretary of the Budget,
- the Puerto Rico Government Employees Retirement System,
- the Puerto Rico Teachers' Retirement System, and,
- the Texas County & District Retirement System.

Glenn has peer reviewed Milliman's audits of the Arizona State Retirement System and the United Nations Joint Staff Pension Fund, and has audited:

- the Retirement Systems of Alabama,
- the Indiana Public Employee Retirement Fund,
- the Kentucky Teachers Retirement System, and
- the State Teachers Retirement System of Ohio.

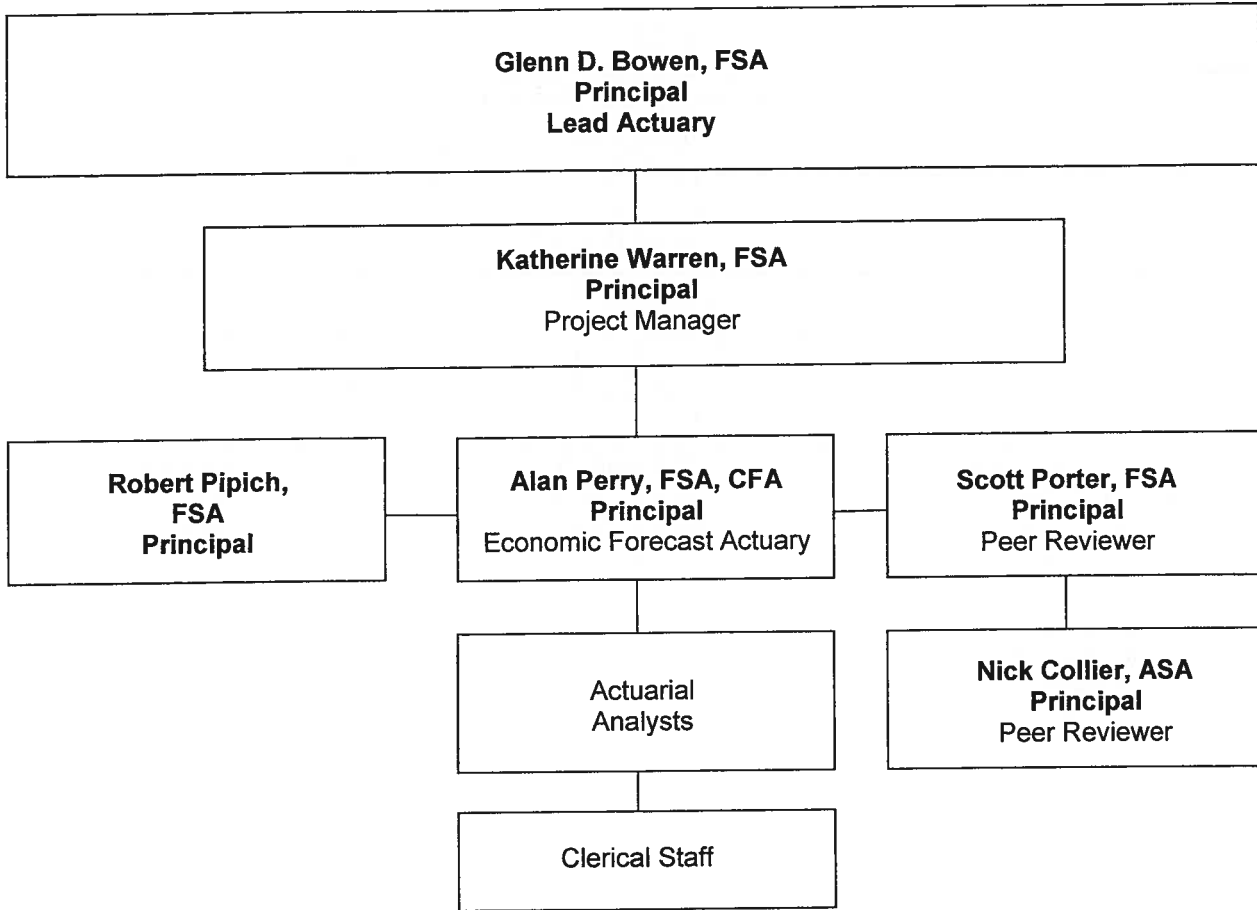
Scott F. Porter, FSA will serve as peer review actuary and lead the audit of the Experience Review. For the past 21 years, Scott's work has been related to retirement plans. Within the public sector, Scott serves as the actuary for the New Jersey Teachers' Pension and Annuity Fund, Manhattan and Bronx Surface Transit Operating Authority, Southeastern Pennsylvania Transportation Authority, and City of Dover, Delaware. He has audited numerous systems including:

- the Indiana Public Employee Retirement Fund,
- the Manhattan and Bronx Surface Transit Operating Authority,
- the Pennsylvania Public School Employees' Retirement System (twice),
- the Pennsylvania State Employees' Retirement System,
- the Staten Island Rapid Transit Operating Authority, and,
- the United Nations Joint Staff Pension Fund.

Other members of the consulting team are Robert Pipich, FSA, Alan Perry, FSA, Katherine Warren, FSA, and Nick Collier, ASA. Each of these consultants has extensive experience in working with public employee retirement systems; they are all highly qualified consulting actuaries.

Kathy Warren will serve as the project manager. Rob Pipich will serve as the health care actuary and will have primary responsibility for reviewing health care cost assumptions. Alan Perry will review economic assumptions. Nick Collier will be available to provide additional peer review assistance.

The following page contains an organizational chart with Milliman's Proposed Consulting Team.



Resumes for the proposed project team are on the following pages.

Glenn D. Bowen FSA, EA, MAAA
Principal, Consulting Actuary

Current Responsibility

Glenn is a principal and consulting actuary with the Philadelphia office of Milliman. He joined the firm in 2001.

Experience

Glenn is experienced in the actuarial valuation of pension and welfare benefits. Special projects have included actuarial audits of two multi-billion public retirement systems, strategic funding analyses, plan redesign studies, executive benefit studies and cost projection models. Glenn was the project leader for a major study of early retirement incentives and cost-of-living adjustments for Pennsylvania school and state employees that was commissioned by the Pennsylvania Legislative Budget & Finance Committee. He currently serves as actuary to the Puerto Rico Government Employees, Judiciary, and Teachers Retirement Systems and the City of Detroit. Glenn led Milliman's research and development efforts for employee stock option valuation. Prior to joining Milliman, Glenn worked in actuarial consulting for five years at Towers Perrin.

Professional Activities

Glenn is the former Chair of Milliman's Public Plan Specialty Practice Group. He is a frequent speaker on employee benefits topics, having addressed many groups, including:

- American Academy of Actuaries
- American Institute of Certified Public Accountants
- Government Finance Officers Association of Pennsylvania
- National Association of State Comptrollers
- Pennsylvania Association of Public Employee Retirement Systems
- Pennsylvania Association of School Business Officials
- Pennsylvania State Association of County Controllers

Selected Bibliography

- Discount Rates: Pension Case Study (International Actuarial Association monograph, in progress, 2011)
- Back to the Benefits Basics: DB or not DB – That is the Question (Benefits Quarterly, 2007, with Alan Perry)
- New GASB Rules for Other Postemployment Benefits Finalized (Milliman Periscope, 2004)
- How Fit is Your Funding Policy? (Milliman Benefits Perspectives, 2003)
- Potential Year-End FAS132 Issues (Philadelphia office client publication, 2001, 2002)

Professional Designations

- Fellow, Society of Actuaries
- Enrolled Actuary, ERISA
- Member, American Academy of Actuaries

Affiliations

- Instructor, Society of Actuaries' "Applied Modeling" examination seminar
- Member, American Academy of Actuaries Employee Stock Option Valuation Task Force

Education

BS, Civil Engineering, University of Delaware
MS, Civil Engineering, University of Delaware

Nick J. Collier ASA, EA, MAAA
Principal, Consulting Actuary

Current Responsibility

Nick is a principal and consulting actuary with the Seattle office of Milliman. He joined the firm in 1987.

Experience

Nick's area of expertise is the employee benefits field, serving a wide range of public and multiemployer clients. He has assisted clients with many aspects of defined benefit plans, including actuarial valuations, experience studies, asset/liability modeling, projections of costs, and the valuation of postretirement benefits. Additionally, Nick has extensive experience performing actuarial audits.

Examples of specific ongoing public sector client projects include:

- System actuary – California State Teachers' Retirement System,
- System actuary – Los Angeles County Employees Retirement Association,
- System actuary – Texas County and District Retirement System,

Examples of specific past public sector actuarial audits include:

- Retirement Systems of Alabama,
- Washington State Retirement System,
- City and County of San Francisco Retirement System,
- San Bernardino County Employees' Retirement Association,
- San Diego County Employees Retirement Association,
- Contra Costa County Employees' Retirement Association, and
- the United Nations Joint Staff Pension Fund.

Nick's other projects have included:

- Creating stochastic asset/liability projection
- Designing retirement benefit calculator for use on the Internet
- Analysis of use of reserves in funding policy
- High-level internal quality control reviews

Professional Designations

- Associate, Society of Actuaries
- Enrolled Actuary, ERISA
- Member, American Academy of Actuaries

Education

BA (cum laude), Mathematics and Economics, Claremont McKenna College

Alan H. Perry, FSA, MAAA, CFA
Principal, Consulting Actuary

Current Responsibility

Alan is a principal and consulting actuary with the Philadelphia office of Milliman. He joined the firm in 1990.

Experience

Alan has had primary responsibility over the last 24 years for preparing actuarial valuations and pricing analyses for prepaid tuition programs in Washington, Ohio, Virginia, Nevada, Alaska, and Wisconsin. He has performed stochastic asset/liability studies for Ohio, Virginia, and Washington and designed an immunized fixed income strategy for Wisconsin.

Alan's experience covers prepaid tuition plans, retirement plans, and insurance organizations. He specializes in the analysis and management of financial risk. He performs asset/liability studies, including stochastic modeling and investment policy work.

Presentations

Alan spoke on actuarial and investment issues of prepaid tuition plans at the National Association of State Treasurers Conference and is a frequent speaker on asset and liability management at industry conferences.

Professional Designations

- Fellow, Society of Actuaries
- Member, American Academy of Actuaries
- CFA Charterholder

Affiliations

- Member of the Financial Analysts of Philadelphia
- Serves on the American Academy of Actuaries Task Force on Employee Stock Options
- Previously served on the Education and Examination Committee of the Society of Actuaries

Education

BBA, Economics, Wharton School, University of Pennsylvania
MS, Actuarial Science, Temple University

Robert J. Pipich FSA, MAAA
Principal, Consulting Actuary

Current Responsibility

Rob is a principal and a consulting actuary with the Health Actuarial practice of Milliman's Philadelphia office. He joined the firm in 2006.

Experience

Rob's expertise resides in healthcare with a focus on the mid to large group markets, Medicare, healthcare reform, and general management.

Rob is currently working with CCIIO on several initiatives to implement and review various aspects of exchange operations. The initiatives include the broad areas of dental, small group, participant cost sharing estimation, and the review of QHP/SADP submissions.

Rob has recently led the submission of Medicare Advantage bids for four medium to large insurers, has completed development and support of Milliman's national Medicare Advantage pricing model, is currently responsible for leading development on the core aspects of the Milliman Ages 65 and Over Health Cost Guidelines, and is involved in a variety of Healthcare Reform and OPEB projects.

Rob's experience also includes risk adjustment and selection, product design, consumer-driven healthcare, and actuarial system design, as well as core actuarial applications such as pricing, reserving, and underwriting support.

Examples of specific ongoing public sector client projects include the development of per capita claims costs and healthcare trend analysis for 100 GASB45 valuations of cities, municipalities, authorities and counties conducted in conjunction with the Philadelphia Employee Benefits practice. Two notable GASB45 clients Rob has worked on are the Metropolitan Transportation Authority (NYC) and the Southeastern Pennsylvania Transportation Authority. Rob has also developed per capita claims costs and healthcare trend for over two dozen FAS106 valuations.

Professional Designations

- Fellow, Society of Actuaries
- Member, American Academy of Actuaries

Education

BS, Pennsylvania State University

Scott F. Porter FSA, EA, MAAA
Principal, Consulting Actuary

Current Responsibility

Scott is a principal and consulting actuary with the Philadelphia office of Milliman. He joined the firm in 1992.

Experience

Scott serves both public and private sector clients regarding their defined benefit pension and retiree health plans. Client assignments include actuarial valuations, cost studies, GASB valuations under 25, 27 and 45. Assignments also include FASB valuations for developing expense and year-end disclosure for FASB ASC Topic 715, and government filings. He has developed cost projection models for private and public sector clients to determine future funding levels and the cost of proposed plan changes. Scott has experience in performing audits for pension plans, including analysis of data, actuarial procedures, and assumptions.

Scott currently consults to the New Jersey Teachers' Pension and Annuity Fund.

Scott also currently consults on the following public pension plans: the Southeastern Pennsylvania Transportation Authority, the Manhattan and Bronx Surface Transit Operating Authority and City of Dover, Delaware General Employees and Police Pension Plans. He also serves as the consulting actuary for the Philadelphia Phillies and the Grand Lodge of Pennsylvania. He has performed GASB 45 actuarial valuations for the Southeastern Pennsylvania Transportation Authority, Delaware County Community College and eight agencies of the Metropolitan Transportation Authority (NYC). Previous actuarial review experience includes the Pennsylvania Public School Employees Retirement System, the Pennsylvania State Employees Retirement System, the New York City Transit Authority (Manhattan and Bronx Surface Transit Operating Authority Pension Plan, and Staten Island Rapid Transit Operating Authority Pension Plan), the Alabama Retirement Systems, and the United Nations Joint Staff Pension Fund.

Bibliography

- Public Plans: Using Risk Profiles to Manage Funding Goals (White paper for Society of Actuaries)

Professional Designations

- Fellow, Society of Actuaries
- Enrolled Actuary, ERISA
- Member, American Academy of Actuaries

Education

BBA (magna cum laude), concentration in Actuarial Science, Temple University

Katherine A. Warren FSA, EA, MAAA
Principal, Consulting Actuary

Current Responsibility

Kathy is a principal and consulting actuary with the Philadelphia office of Milliman. She joined the firm in 1991.

Experience

Kathy serves both public and private sector clients regarding their defined benefit pension plans. Client assignments include actuarial valuations, cost studies, FASB valuations for developing expense and year-end disclosure for FASB ASC Topic 715, and government filings, including preparation of Act 205 filings. Kathy also serves clients with postretirement benefit plans (other than pensions) by performing FASB valuations to comply with FASB ASC Topic 715. She also assists clients in complying with GASB 25, 27, 43, and 45. Kathy has experience developing computer models for valuing the potential costs of an early retirement window and performing asset/liability modeling studies. She also has worked extensively on a client's stand-alone benefit calculation program. Kathy has also assisted several clients through the plan termination process.

In the public sector, Kathy assists the Pennsylvania Public Employee Retirement Commission and has assisted the Ohio Retirement Study Council by primarily providing estimated costs of proposed legislation. She also assists the Puerto Rico Government Employees, Judiciary, and Teachers Retirement Systems and the City of Detroit. Kathy has also served in an internal peer review capacity on several public employee retirement systems, leading a replication valuation of a large state-wide retirement system. Previous actuarial review experience includes the Pennsylvania Public School Employees Retirement System, the Pennsylvania State Employees Retirement System, and the United Nations Joint Staff Pension Fund.

She currently serves on the Editorial Committee of Milliman's *Benefits Perspectives* and chairs Milliman's Systems Enhancement Committee providing oversight into Milliman's valuation software programs. She has also assisted the Joint Board for the Enrollment of Actuaries and the Society of Actuaries in developing the Enrolled Actuaries examinations.

Professional Designations

- Fellow, Society of Actuaries
- Enrolled Actuary, ERISA
- Member, American Academy of Actuaries

Education

BA (summa cum laude), Mathematics, University of Pennsylvania

Section 5

Proposed Methodology, Work Product, and Timeline

We will discuss our proposed methodology for each of the elements and activities as specified in the RFP.

1. Data Validity

The member data used by the actuary is one of the basic foundations of an actuarial valuation. It forms the basis for actuarially projecting the benefits provided to members by PERS. Thus an important step in an actuarial audit is determining the validity of the member data. Our experience has been that this is frequently the most valuable portion of our work because if there are any problems, they are likely to be identified in the process we follow to validate the data.

Our approach is as follows:

- **Active Data Reporting** – We will examine ten individual retirement calculations that were performed subsequent to December 31, 2013 and compare the data on which those benefit calculations were based with the data provided to the actuary by PERS for the immediately preceding actuarial valuation. This allows us to determine if there are any significant discrepancies between these two data sets. In addition, it allows us to identify possible deficiencies in the data, such as information regarding service purchases (at times this data is unavailable to the system if members can apply to purchase service at the time of their retirement application). If there are any systematic problems along these lines, even a small sampling of data will frequently bring that fact to light.
- **Inactive Data Reporting** – We will examine ten individual retirement calculations for members who retired prior to December 31, 2013 and compare the benefit actually chosen by the member with the data supplied to the actuary for the December 31, 2013 actuarial valuation.

2. Actuarial Valuation Method and Procedures

To prepare an actuarial valuation as of a given date and actuary must perform the following steps:

- identify the plan provisions,
- gather necessary data,
- select appropriate actuarial assumptions,
- select an asset valuation method,
- consider the interrelationship between procedures, assumptions and plan provisions, and between the methods used to measure assets and obligations,
- apply an actuarial cost method, and,
- determine the appropriate contribution for the plan year.

Actuarial Standards of Practice

We would review the actuary's methods and procedures regarding each of these steps with the guidance provided in relevant Actuarial Standards of Practice, "ASOP", specifically including the following:

- ASOP 4 – Measuring Pension Obligations,
- ASOP 6 – Measuring Retiree Group Benefit Obligations,
- ASOP 12 – Risk Classification,
- ASOP 23 – Data Quality,
- ASOP 27 – Selection of Economic Assumptions for Measuring Pension obligations,
- ASOP 35 – Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations,
- ASOP 41 – Actuarial Communications, and,
- ASOP 44 – Selection and Use of Asset Valuation Methods for Pension Valuations.

In the event we find that some aspect of the actuary's work that deviates from the guidance in the ASOPs, we will discuss with GRS, the system actuary, the rationale for any deviations encountered and estimate the monetary impact on the valuation results if we do not agree that the deviation was appropriate.

Steps in the Valuation Process

Plan Provisions

We will compare the plan provisions used in the valuation programming with:

- The statutes governing the benefits provided by PERS,
- The Summary Plan Descriptions provided to members, and
- The actual retirement calculations requested for the data validity testing described previously.

In addition, we will review the summary of plan provisions contained in the Actuarial Valuation Report to confirm that it is complete and accurate.

Data

In addition to the data validity testing described previously, we will review the procedures and/or assumptions used by the actuary to "edit" the data for input into their valuation programs. We will request from Gabriel Roeder Smith & Company a copy of the "edited" data file they used as input to their valuation program. We will independently apply their data editing procedures and/or assumptions to the "raw" data as provided by PERS to confirm they were applied accurately. We will also review those editing procedures and/or assumptions for appropriateness.

Actuarial Assumptions

We will address this aspect of our review in **3. Actuarial Valuation Assumptions** below.

Asset Valuation Method

We will review the asset valuation method used by the actuary with the guidance in ASOP 44, and confirm that the calculation was completed accurately.

Interrelationships between the procedures, methods and assumptions, and between the measurement of assets and obligations

We will review all of the procedures, methods and assumptions to assure that they are appropriate for purposes of the PERS valuation. Similarly, we will review the measurement of assets and obligations for consistency.

Actuarial Cost Method and Determination of Contribution Requirements

All five of the Ohio Retirement Systems use the Entry Age Actuarial Cost Method to determine annual contribution requirements and their funding period. We will review the application of the entry age actuarial cost method and the development of the Annual Required Contribution for Accounting purposes and the calculation of the funding period for compliance with the 30-year funding period requirement.

3. Actuarial Valuation Assumptions

We will perform a thorough review of the January 1, 2006 to December 31, 2010 actuarial experience review. To analyze the assumptions relative to experience, we will compare the assumptions with the raw statistics as summarized in the experience investigation. (If the experience study report does not provide detailed tabulations of the experience data, we will request the workpapers or spreadsheets summarizing that information from the PERS actuary.) We will provide our opinion regarding the appropriateness of the analyses completed as well as the appropriateness of the conclusions reached on:

- demographic assumptions (turnover, retirement, mortality, etc.) in light of the guidance in ASOP 35, and,
- economic assumptions (interest rate, salary increases, COLA, etc.) in light of the guidance in ASOP 27.

ASOP 27 is changing effective for measurements on or after September 30, 2014. We will include commentary on the economic assumption under both the ASOP applicable to the December 31, 2013 measurement date and the ASOP applicable for the December 31, 2014 and later measurement dates.

We will make suggestions for possible improvements/modifications for future experience studies that we believe would be beneficial.

We will also review the assumptions used to measure the retiree health care benefit obligations and assess whether they are consistent with the guidance in ASOP 6, which covers the measurement of group retiree benefit obligations.

4. Parallel Valuation

Individual Liability Calculation

Our approach to performing parallel valuations of the pension benefits as of December 31, 2013 and of the retiree health care benefits as of December 31, 2013 will involve first replicating the actuarial calculations for selected individual sample members. The sample member pool will be specified to capture key eligibility/benefit/assumption breakpoints. For example, we will review different sample members impacted by Senate Bill 343 from Groups A, B and C.

This analysis of "test lives" is a routine valuation procedure performed prior to generating full parallel valuation results for the total membership. In order to complete this, we would need to obtain from GRS "test life" or "sample life" output results so that we could compare in detail the results produced by their valuation system with the results produced by ours. We would be glad to either (a) identify the individual situations to be tested in this way, or (b) use lives selected by GRS, provided that they cover an appropriate mix of situations to adequately test our programming against their system.

Full Parallel Valuation Runs

Once we have successfully completed this "test life" effort, we would run the final edited data file used by GRS to run the December 31, 2013 valuations through Milliman's pension and retiree medical valuation system to replicate the valuation results in total. We would run this full parallel valuation using GRS's edited data files to avoid introducing discrepancies into the results due to possible differences in the data editing procedures.

While we expect to be able to replicate GRS's results fairly closely, it is almost certain that we will not be able to reproduce their figures to the dollar due to technical differences in the structures of our actuarial

valuation systems. In any event, we will report to ORSC the figures produced by Milliman's replication and compare them to the results shown in the PERS valuation report. We will do this separately for the basic pension benefits as well as for the retiree healthcare GASB 43 valuation.

Recommended adjustments

In the event we recommend any assumption and/or methodology adjustments to more accurately reflect the present and future assets, liabilities, and costs of PERS, we will provide a detailed explanation for why we believe those modifications would improve the valuation process and indicate the general effect on PERS's condition if those recommendation(s) were adopted.

5. Review of Health Care

As indicated in the RFP, another purpose of this audit is to determine whether retiree contributions to health care benefits are being determined appropriately and consistently for all benefit groups. We will review PERS' policy for determining retiree contributions for healthcare benefits since 2000. This review will include a comparison of the actual costs with the premiums established by PERS. Retiree contributions are determined as a function of the premiums established by PERS.

After reviewing the policy, we will also independently verify the January 2014 monthly contributions for a sample of retirees, disabled retirees, and surviving spouses as of December 31, 2013. This sample will consist of the ten members selected for the inactive data reporting discussed earlier and two surviving spouses. The completed open enrollment forms for 2014 for these members will be requested.

Our report would include the results of our review of the policy and the independent verification of the implementation of the policy.

Assistance needed

Based on our experience with other large public retirement systems, we do not anticipate needing an initial meeting with PERS or with their actuary, GRS. We will provide an initial data collection request to each to obtain plan provisions, data, health plan information, etc. After receiving the initial data, we will discuss with GRS an approach for selecting the "test lives" to be run through their valuation system for us to complete the individual liability calculation portion of our work. Depending on how closely our initial attempt replicates their individual liability calculations, we may need some follow-up assistance from them to identify the source of any differences. This may require assistance from someone at GRS familiar with the details of the programming of their valuation system. We anticipate that these preliminary discussions can take place via phone or e-mail.

We do not anticipate needing any space from ORSC, PERS or GRS.

Written Report

All of our findings, including any recommendations, will be set forth in a full report, including an executive summary with a high-level presentation of the key findings, and a full report providing more detail that may be of use to the ORSC staff, System staff and/or their actuary.

After our internal peer review process is completed, we will provide a preliminary draft of the report to the ORSC Director, the PERS Executive Director, and to GRS for review before the report is finalized. We believe that this is an important step to assure that any observations in the preliminary draft report that may be based on misunderstandings of the information provided to us can be modified appropriately before the report is finalized.

Further, if PERS wishes to provide a comment letter for inclusion in our final report we would welcome that as a way to provide readers of the report with additional information. For example, the STRS Executive Director provided a letter summarizing their responses to our five major recommendations from the 2009 actuarial audit of Ohio STRS, and that response letter was included in the final audit report.

Included in this proposal under Appendix C is the actuarial audit report that we prepared for the State Teachers Retirement System of Ohio in 2009.

ORSC and Board Presentations & Follow-up

In addition to providing our findings in report form, we will present our findings to the ORSC and the PERS Board. The consulting team will remain available to the ORSC and PERS for follow-up questions after the entire audit project has been completed.

Timeline and data/information required

We normally would expect to complete the actuarial audit in 3 to 4 months after commencement of work. The exact scheduling will be affected by when we receive the data and other information we request, and whether we have difficulty replicating GRS' figures.

Our initial step will be to provide initial data and information requests to both PERS and GRS. Some of this will be material previously prepared (such as our request that PERS provide us with the member data files provided to GRS), while other materials may require some effort by PERS or GRS to gather. We will appreciate receiving information as soon as it is available rather than having everything held until it all can be sent. In that way we can start portions of the work without delay.

As soon as we receive from PERS the member data files they provided to GRS as part of our initial data/information request, we will identify the 20 members for whom we will need the benefit calculation workpapers for the data validation task and make that follow-up request of PERS. We will also identify the 12 members for whom we will need the completed 2014 open enrollment forms.

After we receive the complete actuarial assumption sets and the edited data files from GRS (we would hope to receive this information within 2 weeks or so of the initial request), we will discuss with them the selection of the "test lives". We anticipate requesting approximately 10 such "test lives" (6 active members, 2 in pay members and 2 terminated members) for whom we will need to have GRS provide us with detailed valuation results. The detailed valuation results for each such active member "test life" ideally should indicate the value of the benefits for each of the individual decrements (e.g., separate values for withdrawal benefits, early retirement benefits, normal retirement benefits, death benefits, disability benefits, etc.) along with the projected service, earnings, and projected benefits at each age. By providing detail regarding the results from their valuation program, we hope to be able to minimize the follow-up effort required from GRS answering questions from us as we attempt to replicate their calculations. We would hope to receive their "test life" valuation output roughly 2 weeks after identifying the lives to be tested.

Our initial data request for GRS will also describe the detailed information we desire to review regarding their 5-year experience review. As noted above, we will need the detailed tabulations of the experience data. If this is not included in GRS' report, we will request their workpapers or spreadsheets that summarize that information.

We would expect to need approximately 6 to 8 weeks following receipt of substantially all of the information described above to complete the audit report. We will be glad to provide periodic, such as biweekly, briefings to ORSC and PERS regarding our progress.

Reliance on data and other information provided

In performing the actuarial audit, we will rely on data and other information provided by PERS and its consulting actuary. We will not audit or verify this data and other information beyond the steps indicated in this proposal, such as the data verification steps and the parallel valuation. If the underlying data or information is inaccurate or incomplete, the results of our analysis may likewise be inaccurate or incomplete.

If there are material defects in the data or other information, it is possible that they would be uncovered by a detailed, systematic review to search for values that are questionable or for relationships that are materially inconsistent. Such a review will be beyond the scope of the assignment.

Section 6

Glossary

Actuarial Assumptions

Assumptions as to the occurrence of future events affecting pension costs, such as: mortality, withdrawal, disablement and retirement; changes in compensation and national pension benefits; rates of investment earnings and asset appreciation or depreciation; procedures used to determine the actuarial value of assets; and other relevant items.

Actuarial Cost Method

A particular technique used to establish the amount and incidence of the annual actuarial cost of plan benefits.

Actuarial Equivalent

Of equal actuarial present value, determined as of a given date with each value based upon the same set of actuarial assumptions.

Actuarial Gain or Loss

A measure of the difference between actual experience and that which is expected based upon a set of actuarial assumptions, during the period between two actuarial valuation dates, as determined in accordance with a particular actuarial cost method.

Actuarial Value of Assets

The value of cash, investments and other property belonging to a pension plan, as used by the actuary for the purpose of an actuarial valuation.

Amortization Payments

That portion of the pension plan contribution which is designated to pay interest on and to amortize unfunded liabilities.

ERISA

The Employee Retirement Income Security Act of 1974.

Normal Cost

That portion of the present value of future pension plan benefits and expenses which is allocated to a valuation year by the actuarial cost method.

Section 7

Cost Information

The estimated budget for the Actuarial Audit of the Public Employees' Retirement System of Ohio is summarized below. The not-to-exceed amount for this project is \$116,800.

Person / Expense	Estimated Number of Hours	Hourly Rate	Total Fees
Glenn Bowen	50	\$440	\$22,000
Scott Porter	16	420	6,720
Rob Pipich	6	475	2,850
Kathy Warren	40	420	16,800
Alan Perry	5	420	2,100
Actuary	80	345	27,600
Health Care Actuary	6	375	2,250
Analyst	140	225	31,500
Clerical	8	95	760
Subtotal	351		112,580
Airfare			2,720
Hotels/meals			1,000
Out-of-pocket travel			400
Other expenses			100
Total			\$116,800

Our standard Consulting Services Agreement is attached in Appendix A. Milliman assumes no responsibility for performance prior to the execution of a contract acceptable to both parties.

Appendix A

Consulting Services Agreement

We have shown below our standard consulting services agreement. We would be glad to use this agreement for our work for the ORSC or negotiate other mutually agreeable provisions.

CONSULTING SERVICES AGREEMENT

This Agreement is entered into between Milliman, Inc. (Milliman) and the Ohio Retirement Study Council ("Plan Sponsor") as of _____. Plan Sponsor has engaged Milliman to perform actuarial and consulting services related to its retirement plan(s). Such services may be modified or expanded from time to time. In consideration for Milliman agreeing to perform these services, Plan Sponsor agrees as follows:

- 1. Engagement Terms.** Plan Sponsor acknowledges the obligation to pay Milliman for services rendered, whether arising from Plan Sponsor's request or otherwise necessary as a result of this engagement, at Milliman's standard hourly billing rates for the personnel utilized plus all out-of-pocket expenses incurred. Milliman will bill Plan Sponsor periodically for services rendered and expenses incurred. All invoices are payable upon receipt. Milliman reserves the right to stop all work if any bill goes unpaid for 60 days. Furthermore, Milliman's engagement may be terminated upon ninety days written notice by Milliman or Plan Sponsor. Regardless of the reason for termination of services, Milliman shall be entitled to payment for services completed prior to such termination and Milliman shall retain any records it has relating to the Plan Sponsor plans for a period of at least three years from date of termination. If Milliman's assistance is reasonably required past termination, such services shall be provided at Milliman's then standard hourly rate unless another basis is agreed to by both parties.
- 2. Tool Development.** Milliman shall retain all rights, title and interest (including, without limitation, all copyrights, patents, service marks, trademarks, trade secret and other intellectual property rights) in and to all technical or internal designs, methods, ideas, concepts, know-how, techniques, generic documents and templates that have been previously developed by Milliman or developed during the course of the provision of the Services provided such generic documents or templates do not contain any Plan Sponsor Confidential Information or proprietary data. Rights and ownership by Milliman of original technical designs, methods, ideas, concepts, know-how, and techniques shall not extend to or include all or any part of the Plan Sponsor's proprietary data or Plan Sponsor Confidential Information. To the extent that Milliman may include in the materials any pre-existing Milliman proprietary information or other protected Milliman materials, Milliman agrees that Plan Sponsor shall be deemed to have a fully paid up license to make copies of the Milliman owned materials as part of this engagement for its internal business purposes and provided that such materials cannot be modified or distributed outside the Plan Sponsor without the written permission of Milliman.
- 3. Limitation of Liability.** Milliman will perform all services in accordance with applicable professional standards. The parties agree that Milliman, its officers, directors, agents and employees, shall not be liable to Plan Sponsor, under any theory of law including negligence, tort, breach of contract or otherwise, for any damages in excess of three (3) times the total professional fees paid to Milliman during the 12 month plan year cycle during which the work in question is performed. In no event shall Milliman be liable for lost profits of Plan Sponsor or any other type of incidental or consequential damages. The foregoing limitations shall not apply in the event of the intentional fraud or willful misconduct of Milliman. The provisions of this Section will survive the expiration or termination of this Agreement.

4. **Disputes.** Dispute Resolution

- a. **Mediation.** In the event of any dispute arising out of or relating to the engagement of Milliman by Plan Sponsor, the parties agree first to try in good faith to settle the dispute voluntarily with the aid of an impartial mediator who will attempt to facilitate negotiations. A dispute will be submitted to mediation by written notice to the other party or parties. The mediator will be selected by agreement by the parties. If the parties cannot agree on a mediator, a mediator will be designated by the American Arbitration Association at the request of a party. The mediation will be treated as a settlement discussion and therefore will be confidential. Any applicable statute of limitations will be tolled during the pendency of the mediation. Each party will bear its own costs in the mediation. The fees and expenses of the mediator will be shared equally by the parties.
 - b. **Arbitration.** If the dispute has not been resolved within 60 days after the written notice beginning the mediation process (or a longer period, if the parties agree to extend the mediation), the mediation will terminate, and the dispute will be resolved by final and binding arbitration under the Commercial Arbitration Rules of the American Arbitration Association. The arbitration will be before a panel of three arbitrators. Within 30 days of the commencement of the arbitration, each party will designate in writing a single neutral and independent arbitrator. The two arbitrators designated by the parties will then select a third arbitrator. The arbitrators will have a sufficient background either in employee benefits, actuarial science, or law to reasonably prepare them to decide a dispute. The arbitrators will have the authority to permit limited discovery, including depositions, prior to the arbitration hearing, and such discovery will be conducted consistent with the Federal Rules of Civil Procedure. The arbitrators will have no power or authority to award punitive or exemplary damages. The arbitrators may, in their discretion, award the cost of the arbitration, including reasonable attorney fees, to the prevailing party. Any award made may be confirmed in any court having jurisdiction. Any arbitration shall be confidential, and except as required by law, neither party may disclose the content or results of any arbitration hereunder without the prior written consent of the other parties, except that disclosure is permitted to a party's auditors and legal advisors.
5. **No Third Party Distribution.** Milliman's work is prepared solely for the use and benefit of Plan Sponsor in accordance with its statutory and regulatory requirements. Milliman recognizes that materials it delivers to Plan Sponsor may be public records subject to disclosure to third parties; however, Milliman does not intend to benefit and assumes no duty or liability to any third parties who receive Milliman's work, and Milliman may include disclaimer language on its work product so stating. Plan Sponsor agrees not to remove any such disclaimer language from Milliman's work. To the extent that Milliman's work is not subject to disclosure under applicable public records laws, Plan Sponsor agrees that it shall not disclose Milliman's work product to third parties without Milliman's prior written consent; provided, however, that Plan Sponsor may distribute Milliman's work to (i) its professional service providers who are subject to a duty of confidentiality and who agree to not use Milliman's work product for any purpose other than to provide services to Plan Sponsor, or (ii) any applicable regulatory or governmental agency, as required.
6. **Handling of Data and Other Confidential Information.** Milliman shall use reasonable efforts to identify errors in data and obtain corrections to erroneous data, but Milliman cannot warrant the correctness of data supplied by Plan Sponsor or other parties, nor can Milliman be responsible for data not provided in a timely manner. Any information received from Plan Sponsor will be considered "Confidential Information." However, information received from Plan Sponsor will not be considered Confidential Information if (a) the information is or comes to be generally available to the public during the course of Milliman's work; (b) was independently developed by Milliman without resort to information from the Plan Sponsor; or (c)

Milliman Proposal

Milliman receives the information from another source who is not under an obligation of confidentiality to Plan Sponsor. Milliman agrees that Confidential Information shall not be disclosed to any third party.

- 7. **Status of Milliman.** Milliman will provide the services covered by this agreement as an independent contractor. No other relationship to the Plan Sponsor nor the plan is implied or intended. Milliman shall not be deemed to be a "named fiduciary" or "plan administrator" as these terms are defined under ERISA or any similar or successor law.

- 8. **Choice of Law.** The construction, interpretation, and enforcement of this Agreement shall be governed by the substantive contract law of the State of New York without regard to its conflict of laws provisions. In the event any provision of this Agreement is unenforceable as a matter of law, the remaining provisions will stay in full force and effect.

MILLIMAN, INC.

OHIO RETIREMENT STUDY COUNCIL

By: _____
Name: _____
Title: _____
Date: _____

By: _____
Name: _____
Title: _____
Date: _____

Appendix B

Sample Milliman Publications

29 plans lowered their interest rate assumptions,
which increased their accrued liabilities and lowered their funded ratios

Most plans are setting their interest rate assumptions in a realistic manner
consistent with long-term market return expectations

Funded ratios are down slightly



Rebecca A. Sielman
FSA, MAAA, EA

Introduction

The Milliman Public Pension Funding Study uses an approach to measure the aggregate funded status of the 100 largest U.S. public pension plans that is unique among studies assessing the health of the country's public pension plans. Our study independently determines an actuarial interest rate assumption for each plan based on its unique asset allocation and Milliman's current outlook on future long-term investment returns, then uses the actuarially determined interest rates to recalibrate each plan's accrued liability. We found that the total recalibrated accrued liability for the plans in the study was just 2.6% larger than the total accrued liability reported by the plans. While the challenge of funding future pension promises remains considerable, our study results indicate that most plans have set their interest rate assumptions and measured their pension liabilities in a realistic, actuarial manner that is consistent with long-term market return expectations. There is more than one way to put a dollar figure on the value of future pension benefits; the focus of this study is the traditional budgeting approach of assessing liability based on the long-term returns expected to be earned by plan assets.

A notable finding of this year's study is that 29 of the 100 plans in the study have lowered their interest rate assumptions since the

Milliman 2012 Public Pension Funding Study. The median interest rate used by the plans decreased from 8.00% in the 2012 study to 7.75% in the 2013 study. This drop is in line with a generally declining market consensus on expected long-term investment returns; our study's median actuarially determined interest rate similarly decreased from 7.65% in the 2012 study to 7.47% in the 2013 study. Note that lower interest rate assumptions cause accrued liabilities to increase and funded ratios to fall.

Plans report on the size of their assets in two ways: *market value*, which is well understood; and *actuarial value*, which reflects asset smoothing techniques designed to moderate year-to-year fluctuations in contribution amounts but which may deviate significantly from market value in periods of sizeable market gains or losses. The 100 plans in this study reported assets totaling \$2.58 trillion on a market value basis and \$2.73 trillion on an actuarial value basis. By comparison, reported assets in the Milliman 2012 Public Pension Funding Study stood at \$2.51 trillion on a market value basis and \$2.71 trillion on an actuarial value basis.

Funded ratios have fallen slightly in the Milliman 2013 Public Pension Funding Study relative to the 2012 study, reflecting changes in both

FIGURE 1: MILLIMAN 100, AGGREGATE FUNDED STATUS

\$ TRILLIONS	2012		2013	
	REPORTED FIGURES	RECALIBRATED FIGURES	REPORTED FIGURES	RECALIBRATED FIGURES
Interest rate (median)	8.00%	7.65%	7.75%	7.47%
Interest rate (liability-weighted)	7.80%	7.55%	7.67%	7.44%
Accrued liability	\$3.80	\$3.71	\$3.77	\$3.86
Market value of assets	\$2.51	\$2.51	\$2.58	\$2.58
Actuarial value of assets	\$2.71	\$2.71	\$2.73	\$2.73
Funded ratio using market value of assets	69.8%	67.8%	68.5%	68.8%
Funded ratio using actuarial value of assets	75.1%	73.0%	72.4%	70.6%
Unfunded accrued liability using market value of assets	\$1.09	\$1.20	\$1.19	\$1.28
Unfunded accrued liability using actuarial value of assets	\$0.89	\$1.00	\$1.04	\$1.13

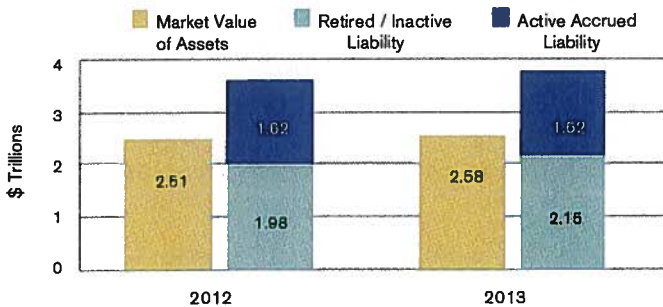
assets and liabilities. On the asset side, for more than half of the plans in this study the most recent valuation information available is as of July 1, 2012. The 12-month period from July 2011 to July 2012 generally saw disappointing investment results, with market returns hovering around 1% to 2%. On the liability side, 29 of the plans in this study lowered their interest rate assumptions and therefore increased their reported accrued liabilities.

The larger plans in the study tend to be somewhat better funded than the smaller plans in the study. The top quartile of plans by reported funded ratio accounts for 35% of the aggregate reported accrued liabilities, whereas the bottom quartile of plans accounts for just 18% of the aggregate reported accrued liabilities.

Liabilities

The plans reported aggregate accrued liabilities of \$3.77 trillion. This total breaks down into \$1.62 trillion for the 12.6 million plan members who are still working plus \$2.15 trillion for the 11.8 million plan members who are retired and receiving benefits or who have stopped working but have not yet started collecting their pensions. The number of active members has declined by 200,000 relative to the Milliman 2012 Public Pension Funding Study, whereas the number of inactive members has grown by 900,000. In aggregate, the plans currently have assets sufficient to cover 100% of the reported accrued liability for retirees and inactive members but only 27% of the assets needed to cover the reported accrued liability for active plan members.

FIGURE 2: ACCRUED LIABILITY



Interest rate assumption

There are three sources of money to pay for public pension benefits: payroll deductions from active members, contributions from plan sponsors, and investment income generated by plan assets. When actuaries advise plan sponsors on contribution policy, they estimate what level of future investment income a plan's assets are likely to earn. Different types of investments carry different long-term expectations for investment earnings, so the actuary starts with return assumptions for each of the different asset classes. Collectively, these return assumptions, along with the associated variances and coefficients of correlation with other asset classes, are known as *capital market assumptions*. The actuary then takes into account each particular pension plan's allocation of investments across the different asset classes and arrives at the expected long-term average annual rate of return for the pension plan. This expected rate of return is used to discount projected future benefit payments back to the present time so that those future payments are expressed in today's dollars. Using this methodology to determine the plan's liabilities, if the plan sponsor always pays the amounts determined using actuarially sound methods and if the actual future investment results are equal to the interest rate assumption, then the plan should accumulate sufficient assets to pay benefits when due.

Capital market assumptions

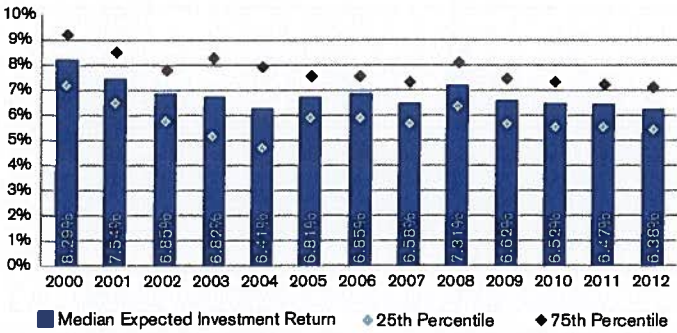
One of the most significant trends over the past decade is that the market's consensus views on long-term future investment returns have slid downward. Figure 3 illustrates this trend by showing the expected long-term return for a hypothetical asset allocation based on Milliman's capital market assumptions for each year since 2000. Over this period, expected returns on both equity and fixed-income investments have fallen by about 200 basis points. Pension plans have reflected this trend by lowering their interest rate assumptions, in some cases by making a single significant cut and in other cases by making gradual reductions. Where assumptions of 8.5% were once commonplace, over half of the plans in the study now have assumptions of 7.75% or below. With lower interest rate assumptions come higher reported accrued liabilities; for many public pension plans, a 100-basis-point reduction in the interest rate assumption causes an 11% to 15% increase in accrued liability, which in turn causes a reduction in the

Methodology

This study is based on the most recently available Comprehensive Annual Financial Reports and valuation reports, which reflect valuation dates ranging from June 30, 2010, to December 31, 2012; about two-thirds are from June 30, 2012, or later. For the purposes of this study, the reported asset allocation of each of the included plans has been analyzed to determine an independent measure of the expected long-term annual geometric average rate of return on plan assets. The reported accrued liability for each plan has then been recalibrated to reflect this actuarially determined interest rate. This study therefore adjusts for differences between each plan's assumed rate of investment return and a current market assessment of the expected return based on actual asset allocations. This study is not intended to estimate the plans' liabilities for settlement accounting purposes or to analyze the funding of individual plans.

reported funded ratio and an increase in the contributions needed to fund the plan over the long term. If market outlooks remain at current levels or continue to decline, it is likely that plans will continue to reduce their interest rate assumptions.

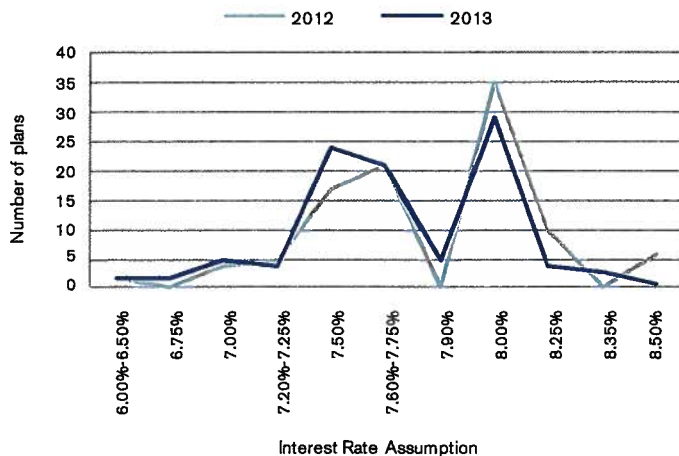
FIGURE 3: EXPECTED RETURN FOR A HYPOTHETICAL ASSET ALLOCATION BASED ON MILLIMAN'S CAPITAL MARKET ASSUMPTIONS



Asset allocation: 35% broad U.S. equities, 15% developed foreign equities, 25% core fixed income, 5% high yield bonds, 10% mortgages, 5% real estate, and 5% cash; inflation assumption is fixed at 2.5% for all years.

There is a wide diversity of investment allocations among the plans in this study, which in and of itself would naturally result in a diversity of interest rate assumptions. Expert opinion also varies regarding the expected long-term returns for different asset classes, and plans may have different attitudes about the appropriate level of conservatism to build into their interest rate assumptions. It is therefore not surprising that there is a wide spread of interest rate assumptions reported by the plans in this study, as shown in Figure 4.

FIGURE 4: INTEREST RATE ASSUMPTIONS REPORTED BY PLANS



The median of the interest rate assumptions reported by plans in this study is 7.75% (7.67% on a liability-weighted basis), down from a median of 8.00% (7.80% liability-weighted) in the Milliman 2012 Public Pension Funding Study. Since the 2012 study, 29 of the plans have lowered their interest rate assumption, most by 25 to 50 basis points. At an aggregate level, there were no significant changes in asset allocations during this period, so the drop in interest rate assumptions reflects the general consensus trend among investment professionals toward lower expected long-term returns on most asset classes.

Recalibrating the accrued liability

We independently applied a “building-block approach” to each plan’s unique asset allocation, and determined the 50th percentile 30-year geometric rate of return based on Milliman’s December 31, 2012, capital market assumptions. We then applied the plan’s reported inflation assumption to arrive at our independent, actuarially determined interest rate. The median of the resulting interest rates is 7.47%, which is 28 basis points lower than the median interest rate assumption reported by the plans and 18 basis points lower than the 7.65% median rate from the Milliman 2012 Public Pension Funding

Interest rates and accrued liabilities: Asking the right question

How much are our pension promises worth? This is a question being asked with increasing urgency as plan sponsors grapple with how to cope with underfunded pension plans. But there is more than one way to determine the answer to this question, and the choice of calculation method depends on why the question is being asked.

To illustrate, consider a very different question: How much is New York City’s Central Park worth? If the question is being asked in the context of gauging its aesthetic value, or its value as a recreational space, or its value as a green space converting carbon dioxide to oxygen, then the answer can be determined accordingly. But imagine how different the answer would be if the question is being asked in the context of developing Central Park’s acreage and filling those green spaces with high-rise apartments and office buildings.

Similarly, putting a dollar figure on pension promises depends on the background for asking the question. If the context for the question is to determine what it would cost to shut down the pension plan today or to transfer responsibility for future pension benefits to an insurance company, then the answer is arrived at by discounting future pension payments using current market interest rates. But if the context for the question is to do long-range budgeting and to work out how much should be contributed to the plan this year and next year and 20 years from now, then the answer is arrived at by discounting future pension payments using the long-term expected return on the plan’s investments. Neither answer to the question is more “right” than the other; they are just different answers to a question asked in different contexts.

Study. Figure 5 details how the actuarially determined interest rates compare to the interest rate assumptions reported by the plans; Figure 6 compares the 2013 actuarially determined interest rates to the 2012 actuarially determined interest rates.

FIGURE 5: ACTUARILY DETERMINED INTEREST RATE VS. REPORTED INTEREST RATE

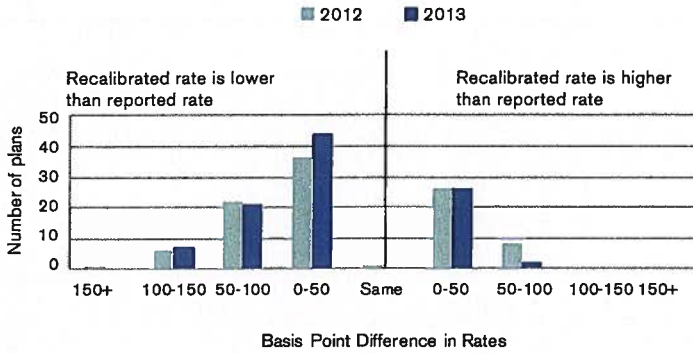
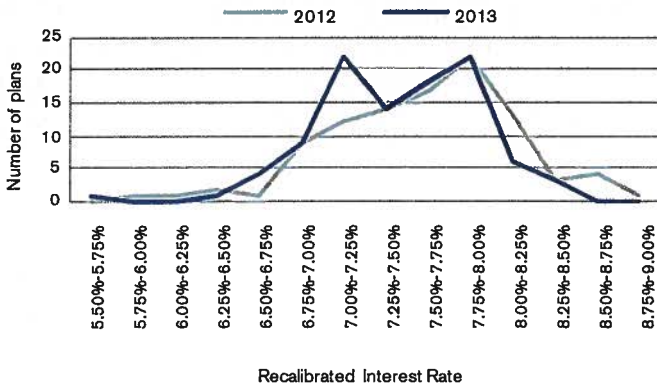


FIGURE 6: ACTUARILY DETERMINED INTEREST RATES IN 2013 VS. 2012

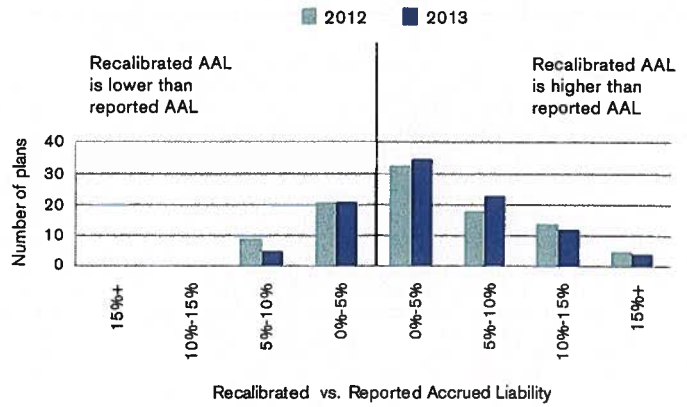


Note that for 28 of the 100 plans the actuarially determined interest rate is higher than the interest rate assumption reported by the plan; this suggests that those plans have included a margin for conservatism in their interest rate assumption.

Recalibrated accrued liabilities

Using each plan's actuarially determined interest rate to recalibrate the accrued liabilities, these plans have an aggregate accrued liability of \$3.86 trillion. For most plans in the study, as was the case in 2012, the recalibrated accrued liability is not substantially different from the reported accrued liability, as shown in Figure 7.

FIGURE 7: RECALIBRATED VS. REPORTED ACCRUED LIABILITY



Sensitivity analysis

A relatively small change in the interest rate assumption can have a significant impact on the accrued liability. The magnitude of the accrued liability impact is a function of the makeup of the plan's membership: a less "mature" plan with more active members than retirees has a higher sensitivity to interest rate changes than a more mature plan with a bigger retiree population. Using an interest rate that is 100 basis points higher or lower than the actuarially determined interest rate moves the aggregate recalibrated accrued liability by 10.6% to 13.5% (see Figure 8), but can move accrued liability by as little as 9.2% for the most mature plans or as much as 15.1% for the least mature plans.

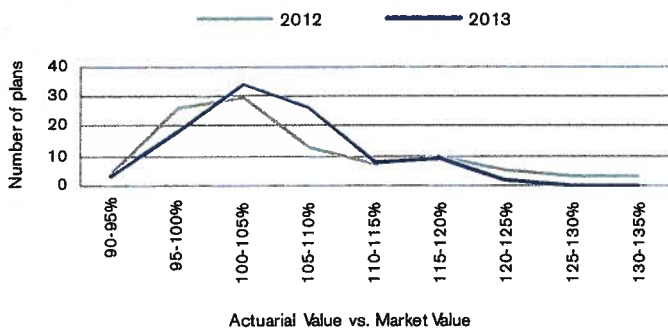
FIGURE 8: EFFECT OF CHANGING THE INTEREST RATE ASSUMPTION

RECALIBRATED ACCRUED LIABILITY (\$ TRILLIONS)	- 100 BASIS POINTS	ACTUARILY DETERMINED INTEREST RATE	+ 100 BASIS POINTS
Most mature 25 plans	\$0.75 (+11.6%)	\$0.68	\$0.61 (-9.2%)
Second most mature 25 plans	\$1.88 (+13.1%)	\$1.49	\$1.33 (-10.4%)
Second least mature 25 plans	\$0.91 (+14.1%)	\$0.79	\$0.71 (-11.1%)
Least mature 25 plans	\$1.04 (+15.1%)	\$0.90	\$0.80 (-11.7%)
All 100 plans in aggregate	\$4.38 (+13.5%)	\$3.86	\$3.45 (-10.6%)

Investments

The plans reported an aggregate market value of assets of \$2.58 trillion and an aggregate actuarial value of assets of \$2.73 trillion, compared with \$2.51 trillion and \$2.71 trillion, respectively, reported in the Milliman 2012 Public Pension Funding Study. Actuarial asset values are designed to reduce year-to-year contribution volatility by systematically recognizing market gains and losses over a multiyear period, typically three to five years. The advantage of asset smoothing techniques is that contribution levels are more consistent from year to year. After periods of large market losses, such as 2000 to 2002 and 2007 to 2009, actuarial asset values may be larger than market values. After periods of large market gains such as the late 1990s, the opposite is generally the case. Figure 9 shows the relationship of these two asset measures for the plans in this study. In both 2012 and 2013, the median ratio of actuarial value to market value was 104%, but the spread of values is somewhat narrower in 2013 than was the case in 2012; that is, fewer plans have a very large divergence between actuarial value and market value.

FIGURE 9: ACTUARIAL VALUE VS. MARKET VALUE



Most pension plans suffered significant asset losses in the timeframe of 2007 to 2009 and additional modest losses in 2011–2012. While there were sizeable gains experienced during 2009 to 2011, those gains were typically not as large as the losses, leading generally to plans with reported actuarial asset values larger than market values. Note that in the pension funding context, a “gain” or “loss” is based on the plan’s actual investment performance relative to the interest rate assumption. While market indices have generally returned to pre-financial crisis levels, many pension plans have not fully recovered from the effects of the market meltdown. As the market gains and losses that were experienced over the past several years are gradually recognized, the relationship of actuarial value to market value will continue to shift. Most notably, much of the large losses suffered during the financial crisis have already been recognized, and many plans will have fully recognized those losses by 2013.

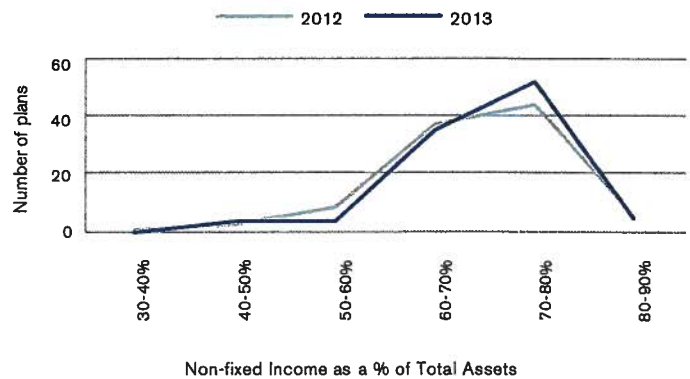
The plans included in this study are invested in a wide array of asset classes, as shown in Figure 10.

FIGURE 10: ASSET ALLOCATIONS

CLASS	2012	2013
Equities	51%	49%
Real estate	6%	8%
Private equity, etc.	13%	15%
Total non-fixed income	70%	72%
Fixed income	26%	25%
Cash	4%	3%
Total fixed income	30%	28%

While the aggregate 2013 investment allocation is 72% in non-fixed income classes and 28% in fixed income, there is considerable investment allocation variation from plan to plan. Figure 11 illustrates this variation, showing the percentage of plan assets invested in non-fixed income classes.

FIGURE 11: PERCENTAGE ALLOCATION TO NON-FIXED INCOME ASSET CLASSES



Asset volatility ratio

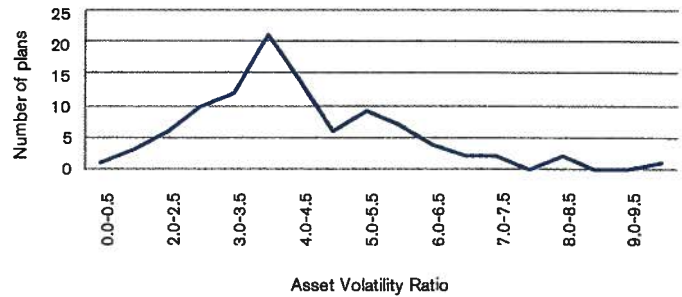
The *asset volatility ratio* is a metric that has been garnering attention lately for its ability to help plan sponsors anticipate the impact of investment volatility on contribution levels. The asset volatility ratio is simply the ratio of plan assets to the payroll for active members covered by the plan. A lower ratio means that plan assets are relatively small compared with payroll; this implies that a large single-year investment gain or loss will not move the contribution rate much. A higher ratio, on the other hand, signals that a fairly small deviation in asset performance could translate into a surprisingly large shift in the contribution rate. It is unsurprising that, as pension plans have accumulated assets and their member populations have matured over the past several decades, asset volatility ratios have risen. These higher ratios mean that contribution rates are now more sensitive than they once were to investment volatility, despite the use of asset-smoothing methods to help mitigate the impact of market movements. Figure 12 illustrates how changes in the asset volatility ratio over time can alter the relationship between investment volatility and contribution volatility.

FIGURE 12: ASSET VOLATILITY RATIO ILLUSTRATION FOR A HYPOTHETICAL PENSION PLAN

	1983	1993	2003	2013
Market value of assets	\$30,000	\$110,000	\$260,000	\$390,000
Covered payroll	20,000	40,000	70,000	80,000
Asset volatility ratio = assets ÷ payroll	1.50	2.75	3.71	4.88
Increase in contribution rate resulting from a 10% asset loss (using 15-year level dollar amortization)	1.58%	2.90%	3.91%	5.14%

The median asset volatility ratio for the plans included in this study is 3.9, and most plans fall within a range of 3.1 to 5.4. However, 18 of the plans have an asset volatility ratio of 5.5 or higher, indicating that their contributions will be more volatile in reaction to market swings.

FIGURE 13: ASSET VOLATILITY RATIOS



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Reported Data

PLAN NAME	VALUATION DATE	ACCRUED LIABILITY	MARKET VALUE			ACTUARIAL VALUE			COUNT OF ACTIVE MEMBERS	COUNT OF INACTIVE / RETIRED MEMBERS
			VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO	VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO		
Employees' Retirement System of Alabama	09/30/11	14,367	8,057	(6,310)	56%	9,456	(4,911)	66%	85,633	52,254
Teachers' Retirement System of Alabama	09/30/11	28,778	16,597	(12,179)	58%	19,430	(9,346)	68%	135,768	97,907
State of Alaska Public Employees' Retirement System	06/30/11	10,919	6,268	(4,651)	57%	6,762	(4,157)	62%	24,393	33,773
Arizona Public Safety Personnel Retirement System	08/30/12	10,328	5,075	(5,251)	49%	8,052	(4,274)	59%	18,542	12,582
Arizona State Retirement System	06/30/12	38,044	26,048	(11,996)	68%	28,549	(9,495)	75%	203,994	328,931
Arkansas Public Employees Retirement System	06/30/12	8,163	5,878	(2,485)	70%	5,625	(2,538)	69%	45,937	42,335
Arkansas Teacher's Retirement System	06/30/11	15,521	11,895	(3,626)	77%	11,146	(4,375)	72%	76,780	44,538
California Public Employees' Retirement System	06/30/11	328,600	241,740	(86,860)	74%	271,389	(57,211)	83%	779,481	851,014
California State Teachers' Retirement System	06/30/12	214,765	134,835	(79,930)	63%	144,232	(70,533)	67%	421,499	440,693
University of California Retirement Plan	07/01/12	54,820	41,806	(12,814)	77%	42,985	(11,855)	79%	116,888	126,252
Chicago Public Schools	06/30/12	17,376	9,437	(7,939)	54%	9,364	(8,012)	54%	30,366	30,171
Municipal Employees' Annuity and Benefit Fund of Chicago	12/31/12	13,475	5,183	(8,292)	38%	5,073	(8,402)	38%	31,328	38,115
Colorado Public Employees' Retirement Association	12/31/11	60,735	37,164	(23,571)	61%	37,185	(23,550)	61%	199,741	186,673
Connecticut State Employees Retirement System	08/30/12	23,019	8,488	(14,551)	37%	9,745	(13,274)	42%	47,868	45,448
Connecticut State Teachers' Retirement System	06/30/12	24,862	13,474	(11,388)	54%	13,735	(11,127)	55%	49,808	46,179
County Employees' Annuity and Benefit Fund of Cook County	12/31/12	13,418	8,060	(5,358)	60%	7,834	(5,584)	58%	21,447	28,030
Delaware State Employees' Pension Plan	06/30/12	7,950	6,915	(1,035)	87%	7,270	(680)	91%	35,427	26,393
Florida State Retirement System	07/01/12	148,050	122,921	(25,129)	83%	127,892	(20,158)	86%	517,287	475,399
Employees' Retirement System of Georgia	06/30/12	16,778	11,537	(5,241)	69%	12,261	(4,517)	73%	63,942	47,051
Teachers' Retirement System of Georgia	08/30/11	65,979	54,084	(11,895)	82%	55,428	(10,551)	84%	218,167	178,581
Employees' Retirement System of the State of Hawaii	06/30/12	20,683	11,286	(9,397)	55%	12,242	(8,441)	59%	65,599	47,683
Public Employee Retirement System of Idaho	07/01/12	13,397	11,330	(2,067)	85%	11,308	(2,091)	84%	65,270	47,973
Illinois Municipal Retirement Fund	12/31/11	30,963	24,834	(6,129)	80%	25,711	(5,252)	83%	175,233	234,182
State Employees' Retirement System of Illinois	06/30/12	33,091	10,981	(22,130)	33%	11,477	(21,814)	35%	62,729	85,902
State Universities Retirement System of Illinois	06/30/12	33,170	13,705	(19,465)	41%	13,950	(19,220)	42%	81,156	81,341
Teachers' Retirement System of the State of Illinois	06/30/12	90,025	36,517	(53,508)	41%	37,945	(52,080)	42%	182,217	204,499
Indiana Public Employees' Retirement Fund	06/30/12	15,784	12,244	(3,540)	78%	12,088	(3,696)	77%	145,519	142,066
Indiana State Teachers' Retirement Fund	08/30/12	20,880	9,077	(11,783)	44%	8,915	(11,945)	43%	70,573	56,338
Iowa Public Employees' Retirement System	06/30/12	29,446	23,025	(6,421)	78%	23,530	(5,916)	80%	164,200	171,454
Kansas Public Employee Retirement System	12/31/11	22,807	12,477	(10,130)	55%	13,379	(9,228)	59%	155,054	126,205
Kentucky Employees Retirement Systems	06/30/12	12,114	3,459	(8,655)	29%	3,599	(8,515)	30%	46,282	51,802
Kentucky Teachers' Retirement System	08/30/12	28,974	14,797	(12,177)	55%	14,891	(12,283)	54%	75,951	52,782
County Employees Retirement System of Kentucky	06/30/12	12,150	7,051	(5,099)	58%	7,295	(4,855)	60%	92,182	64,870
Los Angeles City Employees' Retirement System	06/30/12	14,394	9,059	(5,335)	63%	9,935	(4,459)	69%	24,917	23,031
Water and Power Employees' Retirement Plan of the City of Los Angeles	07/01/12	9,693	7,389	(2,304)	76%	7,574	(2,119)	78%	8,962	10,158
Los Angeles County Employees Retirement Association	06/30/12	50,809	38,307	(12,502)	75%	39,039	(11,770)	77%	91,952	68,859
Los Angeles Fire and Police Pension Plan	06/30/12	17,031	13,269	(3,762)	78%	14,252	(2,779)	84%	13,396	12,442
Louisiana State Employees' Retirement System	06/30/12	16,158	9,516	(6,642)	59%	9,026	(7,132)	56%	52,352	98,111
Teachers' Retirement System of Louisiana	06/30/12	24,540	14,189	(10,351)	58%	13,584	(10,956)	55%	84,513	94,802
Maine Public Employees Retirement System	06/30/12	11,553	8,454	(3,099)	73%	8,881	(2,672)	77%	39,380	30,485
Maryland State Employees' Combined System	06/30/12	20,284	12,631	(7,653)	62%	12,668	(7,616)	62%	85,174	92,511
Maryland Teachers	06/30/12	34,253	22,502	(11,751)	66%	22,524	(11,729)	66%	103,894	88,732
Massachusetts State Board of Retirement System	01/01/12	27,785	18,643	(9,142)	67%	20,508	(7,277)	74%	85,935	58,671
Massachusetts Teachers' Retirement System	01/01/12	36,483	20,129	(16,354)	55%	22,141	(14,342)	61%	88,880	57,408
Michigan Public School Employee's Retirement System	09/30/11	63,427	34,675	(28,752)	55%	41,038	(22,389)	65%	236,660	207,525
Michigan State Employees Retirement System	09/30/12	15,597	8,775	(6,822)	56%	10,212	(5,385)	65%	17,860	62,043
Municipal Employees' Retirement System of Michigan	12/31/11	9,844	5,933	(3,911)	60%	7,150	(2,694)	73%	35,111	35,362
Minnesota State Retirement System	07/01/12	11,083	9,098	(1,985)	82%	9,162	(1,921)	83%	48,207	47,877
Teachers Retirement Association of Minnesota	07/01/12	23,025	16,686	(6,339)	72%	16,805	(6,220)	73%	76,649	95,217
Public Employees Retirement Association of Minnesota	06/30/12	18,599	13,578	(5,021)	73%	13,662	(4,937)	73%	139,330	119,889
Public Employees' Retirement System of Mississippi	06/30/12	34,493	19,781	(14,712)	57%	19,993	(14,600)	58%	162,311	217,970
Missouri State Employees' Plan	06/30/12	10,794	7,582	(3,212)	70%	7,897	(2,897)	73%	51,332	55,342
Public School Retirement System of Missouri	06/30/12	35,588	27,817	(7,771)	78%	29,013	(6,575)	82%	77,529	50,207

Milliman 2013 Public Pension Funding Study

PLAN NAME	VALUATION DATE	ACCRUED LIABILITY	MARKET VALUE			ACTUARIAL VALUE			COUNT OF ACTIVE MEMBERS	COUNT OF INACTIVE / RETIRED MEMBERS
			VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO	VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO		
Nebraska Public Employees Retirement Systems School Retirement System	06/30/12	9,609	7,246	(2,363)	75%	7,359	(2,250)	77%	39,477	40,068
Public Employees' Retirement System of the State of Nevada	06/30/10	35,078	20,906	(14,172)	60%	24,725	(10,353)	70%	102,594	55,726
New Hampshire Retirement System	06/30/12	10,362	5,774	(4,588)	56%	5,818	(4,544)	56%	48,625	29,826
Public Employees' Retirement System of New Jersey	07/01/12	45,393	25,176	(20,217)	55%	28,887	(16,506)	64%	280,158	153,825
Teachers' Pension and Annuity Fund of New Jersey	06/30/12	51,405	26,038	(25,367)	51%	31,079	(20,326)	60%	150,200	89,700
The Police and Firemen's Retirement System of New Jersey	07/01/12	31,732	21,128	(10,606)	67%	23,687	(8,045)	75%	40,819	39,767
Educational Retirement Board of New Mexico	06/30/12	15,837	9,489	(6,348)	60%	9,606	(6,231)	61%	60,855	71,368
Public Employees Retirement Association of New Mexico	06/30/12	17,788	11,600	(6,188)	65%	11,812	(6,176)	65%	48,489	36,823
New York City Employees' Retirement System	06/30/10	62,935	35,384	(27,551)	56%	40,433	(22,502)	64%	184,982	141,428
New York City Police Pension Fund	06/30/10	38,134	19,985	(18,149)	52%	22,909	(15,225)	60%	34,597	44,634
Teachers' Retirement System of the City of New York	06/30/10	55,138	26,398	(28,740)	48%	32,478	(22,660)	59%	111,647	80,526
New York State and Local Employees Retirement System	04/01/11	140,087	130,508	(9,581)	93%	126,395	(13,892)	90%	513,092	478,769
New York State Teachers' Retirement System	06/30/11	89,825	89,890	65	100%	86,892	(2,933)	97%	280,435	146,843
New York State and Local Police & Fire	03/31/12	24,169	22,357	(1,812)	93%	22,205	(1,964)	92%	31,024	34,799
North Carolina Local Governmental Employees' Retirement System	12/31/11	19,374	17,908	(1,466)	92%	19,326	(48)	100%	121,638	96,050
North Carolina Teachers and State Employees Retirement System	12/31/11	61,847	53,402	(8,445)	86%	58,125	(3,722)	94%	310,627	282,472
Ohio Police and Fire Pension Fund	01/01/12	16,347	9,688	(6,659)	59%	10,309	(6,038)	63%	27,463	30,029
Ohio Public Employees Retirement System	12/31/10	79,829	63,816	(15,813)	80%	60,599	(19,030)	76%	356,734	617,999
Schools Employees' Retirement System of Ohio	06/30/12	16,372	10,219	(6,153)	62%	10,284	(6,088)	63%	121,811	81,648
State Teachers Retirement System of Ohio	07/01/12	106,302	60,684	(45,808)	57%	59,490	(46,812)	58%	173,044	160,581
Oklahoma Public Employees Retirement System	07/01/12	8,335	6,821	(1,514)	82%	6,682	(1,653)	80%	42,569	35,760
Teachers' Retirement System of Oklahoma	08/30/12	18,588	10,195	(8,393)	55%	10,190	(8,398)	55%	87,778	81,403
Orange County Employees Retirement System	12/31/11	13,523	8,466	(5,057)	63%	9,064	(4,459)	67%	21,421	17,695
Oregon Public Employees Retirement System	12/31/11	61,198	51,389	(9,809)	84%	50,168	(11,030)	82%	170,972	158,915
Pennsylvania State Employees' Retirement System	12/31/11	42,282	24,371	(17,911)	58%	27,618	(14,664)	65%	107,021	121,531
Public School Employees' Retirement System of Pennsylvania	06/30/12	87,781	48,634	(39,227)	55%	58,228	(29,533)	66%	273,504	324,301
Puerto Rico Government Employees Retirement System	06/30/12	27,646	1,237	(26,409)	4%	1,237	(26,409)	4%	134,566	117,861
Puerto Rico Teachers Retirement System	06/30/11	11,449	2,388	(9,063)	21%	2,388	(9,063)	21%	43,402	36,129
Rhode Island Employees Retirement System	06/30/12	10,670	5,757	(4,913)	54%	6,167	(4,503)	58%	24,378	27,305
Sacramento County Employees' Retirement System	06/30/12	7,898	6,074	(1,784)	77%	6,530	(1,308)	83%	12,155	12,090
San Bernardino County Employees' Retirement Association	06/30/12	8,570	6,173	(2,397)	72%	6,789	(1,781)	79%	19,306	13,518
San Diego County Employees Retirement Association	06/30/12	10,943	8,437	(2,506)	77%	8,807	(2,336)	79%	16,457	20,205
City and County of San Francisco Employees' Retirement System	07/01/12	19,394	15,294	(4,100)	79%	16,028	(3,366)	83%	28,282	30,748
South Carolina Retirement System	07/01/11	40,018	22,395	(17,821)	56%	25,605	(14,411)	64%	192,865	268,382
South Dakota Retirement System	07/01/12	8,453	7,843	(610)	93%	7,828	(625)	93%	38,207	37,161
Tennessee Consolidated Retirement System	07/01/11	40,089	33,662	(6,407)	84%	36,881	(3,388)	92%	215,076	116,585
Texas County & District Retirement System	12/31/12	22,953	19,530	(3,423)	85%	20,250	(2,703)	88%	121,963	115,524
Texas Municipal Retirement System	12/31/12	22,893	20,491	(2,192)	90%	19,784	(2,899)	87%	101,827	87,958
Employees' Retirement System of Texas	08/31/12	29,377	21,826	(7,551)	74%	24,273	(5,104)	83%	132,669	177,989
Teacher Retirement System of Texas	08/31/12	144,427	111,450	(32,977)	77%	118,326	(26,101)	82%	815,155	404,188
Utah Retirement Systems	01/01/12	20,743	15,756	(4,987)	76%	16,615	(4,128)	80%	87,220	81,354
Virginia Employees Retirement System	06/30/11	75,185	50,267	(24,918)	67%	52,559	(22,626)	70%	326,357	186,423
Washington Public Employees' Retirement System	06/30/11	31,382	28,274	(3,108)	90%	29,880	(1,502)	95%	152,417	207,853
Washington State Law Enforcement Officers' and Fire Fighters' Plan 1 and 2	06/30/11	9,710	11,550	1,840	119%	12,186	2,476	125%	17,055	12,284
Washington State Teachers' Retirement System	06/30/11	15,557	13,741	(1,816)	88%	14,626	(931)	94%	66,203	50,913
West Virginia Teachers' Retirement System	06/30/11	9,445	5,075	(4,370)	54%	5,075	(4,370)	54%	35,855	34,291
Wisconsin Retirement System	12/31/11	76,565	71,455	(5,110)	93%	76,466	(99)	100%	256,232	353,525

Study Technical Appendix

Methodology: Expected rate of return on assets

For the purposes of this study, we recalibrated liabilities for included plans to reflect discounting at the expected rate of return on current plan assets. To develop the expected rate of return used in these calculations, we relied on the most recently available asset statements for each plan, particularly on Statements of Plan Net Assets as disclosed in published Comprehensive Annual Financial Reports (CAFRs). We did not make adjustments for potential differences between actual asset allocations and target policy asset allocations.

Our method for calculation of the expected rate of return was the "building-block method" as outlined in Actuarial Standard of Practice No. 27, using geometric averaging methodology. We used Milliman's December 31, 2012, capital market assumptions to calculate the 50th percentile 30-year geometric real rate of return, and then added the plan's inflation assumption to arrive at the total expected investment return on plan assets. Where the plan inflation assumption was not available, we used Milliman's December 31, 2012, capital market inflation assumption of 2.50%. We did not make any adjustment to the expected rate of return for plan expenses, nor did we include any assumption for investment alpha (i.e., we did not assume any excess return over market averages resulting from active versus passive management).

Methodology: Liability recalibration

We performed the recalibration of liabilities for pension plans included in the study using adjustment benchmarks based on detailed calculations for certain pension plans meeting broad categorization definitions. For these benchmark plans, we developed precise liability durations separately for active, terminated vested, and retired member populations. These calculated liability durations were modified durations, further adjusted for plan- and population-specific convexity. We applied a variety of cost of living adjustments (COLAs) to the various benchmark plans, resulting in a library of adjustment factors taking into account plan type, plan provisions, demographic group, and COLA.

We then selected liability adjustment factors for each plan in the study based on plan type, COLA provisions, and average demographic characteristics where available. For example, a teachers' plan was typically matched with a set of teachers' plan adjustment factors, with similar COLA provisions. If average ages, service levels, or expected working lifetimes were available, we also used these criteria to aid in choosing the adjustment factors. For each liability recalibration calculation, we then recalculated the selected benchmark durations to reflect the actual starting plan interest rate assumption. We performed separate liability adjustments for active, terminated vested, and retired liabilities, thereby adjusting for varying plan maturity levels.

The liability durations used for adjustment provide an estimate of the sensitivity of the present value of benefits (PVB) to changes in the interest rate assumption. We assumed that for active populations, the actuarial accrued liabilities (AAL) varied 85% as much as the PVB when liabilities were reported under the projected unit credit cost method, and 70% as much as the PVB when liabilities were reported under the entry age normal cost method. These assumptions for the relative change in AAL compared with PVB were based on the average results of a survey of actual changes in AAL versus PVB for selected Milliman clients. Although most plans in the study reported liability results under one of these two cost methods for Government Accounting Standards Board (GASB) reporting purposes, a handful of plans disclosed liabilities only under the frozen initial liability cost method. For those plans, we used the entry age normal assumption for the relative change of AAL to PVB.

Where any discrepancy occurred between liabilities disclosed for GASB reporting and liabilities disclosed elsewhere, the GASB reporting numbers were relied upon.

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PERISCOPE

Public Employee Retirement Systems

GASB 67/68: New accounting standards for public pension plans

Matt Larrabee, FSA, EA, MAAA

Last month, the Governmental Accounting Standards Board (GASB) published new accounting standards that mark the most significant changes to the pension plan financial reporting of public sector sponsors in a generation. GASB 67 alters financial reporting for pension plans, while GASB 68 modifies reporting requirements for sponsoring employers subject to GASB standards. While compliance with the two standards is not mandatory until 2014 and 2015, respectively, the changes are substantial enough that most sponsors will need advance planning to comply. An implementation guide for the standards has not yet been published, but the material made available so far indicates five major changes that will impact public pension plans and their sponsoring employers.

Change #1: Unfunded actuarial liability, with assets measured at fair value, will be recognized on employer balance sheets

Under the current standards, it is possible for a sponsoring employer to have a substantial unfunded actuarial liability (also known as "UAL" or "shortfall") but still carry little or no balance sheet liability for the plan on its consolidated annual financial report (CAFR). This can be the case as long as the employer consistently contributes its Annual Required Contribution (ARC). The current standards allow significant leeway in determination of the ARC, including the use of asset-smoothing techniques, shortfall amortization periods of up to 30 years, and a variety of actuarial cost allocation methods to attribute projected post-retirement costs to the working careers of plan participants. Since most plans use asset-smoothing techniques, the shortfalls calculated in the first years subsequent to a market downturn, such as in 2008, do not fully reflect the downturn's effects immediately as investment losses are recognized gradually over several years.

Under the new standards, a sponsoring employer of a plan with a shortfall will have the shortfall recognized as a pension plan liability on the balance sheet of its CAFR. The shortfall will be calculated on a fair market value of assets basis, with no allowance for asset-smoothing techniques. Had these standards been in place in 2009, sponsoring employers would have seen a significant increase in the balance sheet shortfall shown in the CAFR after the 2008 downturn. In addition, all shortfall calculations will use a single mandated cost allocation method.

The method specified by GASB (Entry Age) is currently used by the majority of plan sponsors, but sponsors that presently use alternative methods will see changes in their calculated shortfalls due to the mandated switch. Due to variations that exist in applying the Entry Age cost method, even some plans already using Entry Age may need to conform to the specific variation mandated by GASB for accounting purposes, possibly resulting in significant changes in the development of normal costs and liabilities for the plan. Because the new standards de-link funding from accounting, no change in methods is necessary for funding purposes.

Employers that participate in multiple-employer retirement systems that pool experience are not immune from the new standards. The overall system shortfall will be divided among the participating sponsors, with each employer receiving a pro rata share based on its projected portion of future contributions to the system. This is a significant change in accounting procedures for these employers from the prior standards.

Change #2: Calculation of liability is revamped for some plans

In addition to the mandated cost allocation method noted above, the new standards will change the interest rate used to determine the liability (and associated balance sheet shortfall) for some sponsoring employers. Employers affected by this change are likely to see a significant increase in their calculated shortfall.

In calculating the plan liability, the current standards develop a net present value of all future projected benefit payments by discounting those payments using the plan's long-term annual investment return assumption. This is the case even for plans that, due to large shortfalls and/or inadequate funding policies, would not achieve full funding of projected benefits even if all assumptions are met and all funding policy contributions are made.

Under the new standards, plans with the challenges noted above will no longer be able to simply use the investment return assumption to discount all future benefit payments in calculating the liability and associated balance sheet shortfall. Instead, the actuary will assess when the plan's trust assets might be exhausted if all future assumptions (including contributions under the funding policy) are

met. The net present value of payments after the asset exhaustion date would not be discounted using the plan's investment return assumption. Instead, current yields on long-term, tax-free municipal bonds would be used for the discounting of payments after the asset exhaustion date. This will lead to higher reported balance sheet shortfalls for affected sponsors, since future payments discounted at the lower municipal bond rates will lead to higher net present values.

Change #3: Plans will need to develop formal funding policies separate from their financial reporting calculations

Due to the significant flexibility in calculating the ARC under the current standards, the ARC is equal to the funding policy contribution for many plan sponsors. In fact, providing this opportunity for alignment of funding and financial reporting was an objective of GASB when the current standards were issued in 1994. Under the current standards, funding policies can vary substantially for two similarly situated sponsors that both contribute their ARC. The goal of the current standards is to determine the difference between the sponsor's actual contributions and those based on its own funding policies, as long as certain minimum requirements are met. Due to this link between the ARC and the funding policy contribution, the ARC became the de facto funding policy for many sponsors.

The new standards eliminate the ARC calculation and do not provide a parallel replacement. Instead, GASB encourages sponsors to establish a formal, documented funding policy that is separate from the financial reporting calculations. Establishment of such a formal policy and demonstration that the sponsor is adhering to the policy will require sponsor planning in advance of GASB's implementation deadlines.

Change #4: Significantly expanded plan financial disclosures

Under the current standards, plan-related financial disclosures are modest for many sponsors and very limited for sponsors that participate in cost-sharing retirement systems. The new standards significantly lengthen both narrative and numerical disclosures, and there is no major exemption from the expanded disclosures for employers in cost-sharing retirement systems.

Employers will need to provide much more information about plans in which they participate. This includes detailed descriptions of funding and investment policies, the plan's governance structure and statutory authority, and the theoretical underpinnings for key assumptions such as the investment return. Required numerical disclosures include detailed descriptions of year-to-year changes in assets and liabilities plus demonstrations of the sensitivity of shortfalls to changes in the discount rate assumption.

Change #5: Much more volatile annual financial reporting entry amounts for annual plan expense

Many practitioners and sponsors feel the cornerstone number of the current standards is the ARC. The ARC often serves a dual purpose

of acting as both the annual plan expense entry on the financial statements and the de facto funding policy for many sponsors. The significant amount of flexibility allowed in ARC determination methods makes contributing the ARC a viable option for many sponsors.

The cornerstone number of the new standards, by contrast, is the plan liability and its associated balance sheet shortfall. GASB has explicitly de-linked financial reporting standards from funding policy, encouraged sponsors to establish a formal separate funding policy, and emphasized uniformity in the shortfall calculation methodology. All of this means that the annual plan expense entry on the income statement is less of a key focus and instead is more of a mathematical balancing item to get the sponsor's balance sheet from one year-end's shortfall to the next under the new standards.

Because the shortfall under the new standards uses fair market asset values, changes in the shortfall can be significant from year to year. Deviations in annual investment experience from the assumption will be recognized over five years in the annual plan expense financial reporting entry, with the not yet recognized portion held as a deferred expense item. Similar to the way that investment experience is handled, changes in liabilities will be recognized over the expected future working careers of participants. The recognition periods for both investment and liability experience will be markedly shorter than typical amortization periods employed under the current standards, which will result in larger changes from one year to the next under the new standards as compared with the current standards.

For sponsors that are subject to the discount rate changes noted in item #2 above, the reported liability in the shortfall calculation will change annually due to two additional factors. First, annual investment results will affect the projected exhaustion date at which the municipal bond rate index will begin to be used to discount benefit payments. Second, the municipal bond rate will vary from year to year with market conditions, and that variation will also affect reported liabilities and shortfalls.

Employers that participate in cost-sharing retirement systems will recognize a portion of the system's calculated plan expense entry. Employers in these sorts of programs can see an additional volatility factor to those already noted; the employer's proportional share of the system's total expense entry can vary from year to year.

All of the above changes mean that the annual expense entry is simply too volatile to serve as a funding policy, reinforcing GASB's guidance that sponsors develop funding policies that are distinct from the revised financial reporting standards.

In summary, the new GASB standards will take effect soon enough, and the changes mandated are significant enough that sponsors will need to start planning very soon for the implementation of the standards.



PERiSCOPE

Public Employee Retirement Systems

The actuarially calculated cost of public pension plans, whether being used for funding or reporting, has lately attracted unprecedented levels of public attention. By setting actuarial assumptions in accordance with plan experience and the best expectations of actuarial modeling, we attempt to minimize the differences between expected and actual experience as it emerges over time, with the ultimate aim of appropriately funding the plan. Two of the key assumptions that drive actuarial costs are the rate at which liabilities are discounted and the expected longevity of members receiving and expected to receive benefits. In this two-part PERiScope series, we will explore recent trends and theories pertaining to the setting of these assumptions. Part I, "Setting the Discount Rate for Valuing Pension Liabilities," will discuss the fundamental approaches to discount rate setting, recent changes in such rates among public pension plans, and how these rates comply with GASB regulations. Part II, "Mortality, Longevity, and ASOP 35," will explore recent trends in longevity, mortality assumption changes among public pension plans, and how these assumptions comply with Actuarial Standards of Practice.

Setting the Discount Rate for Valuing Pension Liabilities

Daniel Wade, FSA, MAAA, EA

While there are a large number of assumptions necessary to value pension liabilities, none of these assumptions is more significant, visible, or scrutinized than the discount rate. As the name implies, the discount rate is the rate used to discount future benefit payments into an actuarial present value. There is a great deal of controversy about setting the discount rate assumption and even the fundamental framework for setting it.

Two Fundamental Approaches

Modern financial theory indicates that payments should be discounted in a way that reflects the likelihood of payment. Due to the level of commitment (often backed by constitutional protections) that governments have to pay the benefits earned by members, the benefits are nearly certain to be paid. Because of this, adherents believe that a rate based on yields of very high-quality fixed income instruments such as U.S. Treasuries should be used to discount pension liabilities. They believe that the U.S. Treasury market determines the yields required for nearly certain future payments and that the discount rate should be based on an observation of that market. Current yields for long-term Treasuries are under 3%, while yields are even lower for those with shorter maturities. Long-term Treasury yields in the early 1980s were approximately 14%.

By contrast, the traditional actuarial approach used in the public sector sets the discount rate equal to the expected investment

return. Under current standards set by the Governmental Accounting Standards Board (GASB), the terms "discount rate" and "investment return assumption" are used interchangeably and that rate "should be based on an estimated long-term investment yield on the investments that are expected to be used to finance the payment of benefits, with consideration given to the nature and mix of current and expected plan investments."¹

It should be noted that GASB is in the process of reviewing accounting and financial reporting for pension plans. While GASB is proposing numerous fundamental changes, the discount rate will still be based on the "long-term expected rate of return," provided that the plan is not expected to run out of assets. (For additional information, please see PERiScopes issued September 22, 2011, and October 12, 2011, regarding the GASB Exposure Drafts.)

The purpose of the traditional approach is to determine a contribution based on reasonable expectations such that if the plan sponsor has set aside assets today equal to the actuarial present value of benefits and if those assets earn what is expected and people behave as expected, the fund would be liquidated when the last person has died. A long-term expected rate of return is used in order to provide equal probability of "overcharging" or "undercharging" the plan sponsor (i.e., taxpayer) today for future benefits. If the expected investment return assumption is set at

¹ Governmental Accounting Standards Board (GASB) Statement No. 27, paragraph 10.c, and GASB Statement No. 45, paragraph 13.c.

the median of expectations, there is equal probability of having more or less money than necessary to pay the benefits if all other assumptions are met.

Some argue that investing in risky assets and discounting projected benefit payments based on the median investment return “fails to account for the risk borne by future taxpayers who must make good on the benefit promises even if the risky assets fail to perform.”²

They argue that the current generation receives the benefit of the risk through higher discount rates (lower current contributions) than would be used if the discount rate reflected the risk-free nature of the commitment to pay the benefits. Some have argued that having assets equal to a liability measure that reflects the likelihood of payment “defines a system that is fair to future taxpayers.”

Setting the Investment Return Assumption

Assuming that the traditional actuarial approach preferred by GASB for setting the discount rate is used, the fund must determine the expected investment return. This is done by using the capital market assumptions from the fund's investment advisors. The capital market assumptions consist of mean returns and standard deviations for each asset class, as well as the correlation coefficients between asset classes. When making recommendations for the assumption, we compare the capital market assumptions of the fund's investment advisors to those of our firm's investment specialists.

The assumptions may be adjusted if the underlying inflation assumption imbedded in the capital market assumptions is different from the one assumed by the plan. According to the Public Fund Survey, the average inflation assumption used by large public retirement systems is 3.29%. Since the U.S. Treasury started issuing inflation indexed bonds (TIPS), it is possible to determine the approximate rate of inflation anticipated by the financial markets over the next 30 years by comparing the yields on inflation-indexed bonds with traditional fixed government bonds. In a speech in 2004, current U.S. Federal Reserve Chairman Ben Bernanke said that “inflation-indexed securities would appear to be the most direct source of information about inflation expectations.” This analysis implies expectations of inflation rates of about 2.25% as of July 2012, and capital market assumptions by investment advisors tend to be in this range.

Since many funds set their investment return assumptions based on the investment return after inflation (“real” returns), lowering the inflation assumption by 100 basis points could have a similar impact on the investment return assumption. The impact of such a change would be partially offset by the fact that lower inflation also would imply lower wage growth for active members and could imply lower cost-of-living adjustments (COLAs) for members after retirement, both of which would decrease expected future benefit payments.

It is important to keep in mind that all economic assumptions should be based on same underlying inflation assumption to produce a reasonable set of actuarial present values resulting in a reasonable contribution requirement allocated to the current year. Therefore, if the fund uses an inflation assumption greater than those used by the capital market assumptions, an adjustment should be made to reflect the difference.

Using the capital market assumptions and the plan's current target asset allocation, the geometric mean rate of return and standard deviation for the portfolio can be determined. Applying them over different time horizons will yield a distribution of results. We typically assume that the portfolio is re-balanced annually and that annual returns follow a lognormal distribution.

Provision for investment-related expenses and administrative expenses would also need to be considered. If expenses are not valued separately, the final discount rate should be net of expenses. The latest indication from GASB for its new standards is that the long-term expected rate of return is net of investment expenses and gross of administrative expenses. Under that approach, the expected investment fees are deducted from the discount rate, while the administrative expenses are valued explicitly.

Based on the distribution described above, we can then determine a reasonable range of investment returns. A recommendation is often made based on the median rate of return implied by the model; however, as discussed below, the recommendation does not always change as much or as frequently as the returns implied by the model.

Recent Changes in Investment Return Assumptions

According to the 2011 NCPERS Public Fund Study, the average investment assumption for funds responding to the survey is 7.7%. Approximately 23% of responding funds had reduced this assumption in the past two years, and an additional 15% have plans in place to do so within two years. While more recent survey information is not available, anecdotal evidence is that the trend toward lower investment return assumptions has continued. CalSTRS and CalPERS, the nation's two largest pension funds, recently lowered their investment return assumptions from 7.75% to 7.50%.

Most public pension funds change the investment return assumption much more gradually than the capital market assumptions. The investment return assumptions have typically fallen 25 to 50 basis points in their adjustments since the financial crisis of 2008. At the same time, the rates implied by the capital market assumptions of investment advisors have dropped much more significantly.

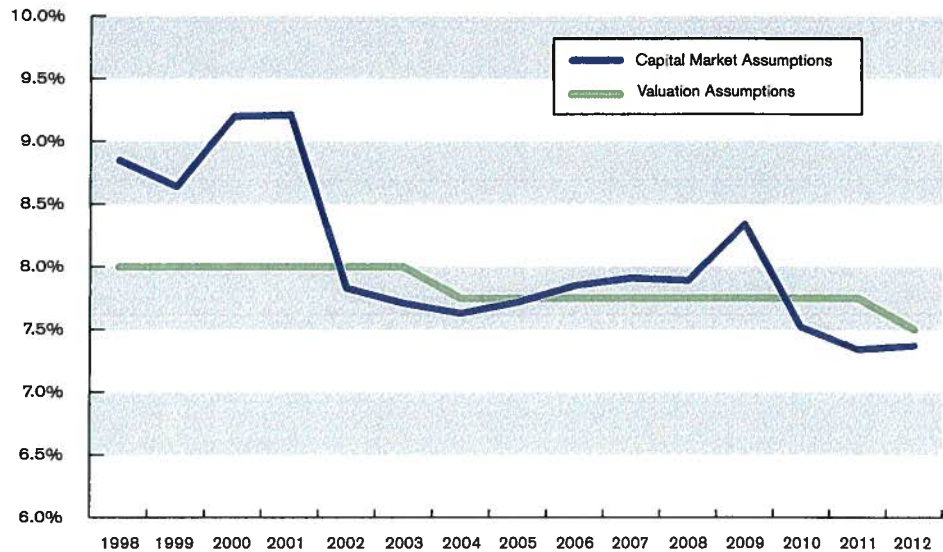
2 Gold, J. & Litter, G. “The Case for Marking Public Plan Liabilities to Market.” *The Future of Public Employee Retirement Systems*, pages 34-35. Oxford University Press.

As of July 2012, long-term bond yields have dropped by approximately 200 basis points from where they were at the beginning of 2011 and over 250 basis points from where they were five years ago. Those yields form the basis for the capital market assumptions for fixed income investments. Expectations for returns on equities are also down significantly. Some base expected equity returns on the risk-free rate of return plus a "risk premium," the expected return on a risky asset assumed to exceed the expected return on a low risk asset. Others base expected equity returns on historical averages, which are now lower than they were prior to the inclusion of the 2008 collapse in the equities markets.

Some view the gradual nature of changes to the investment return assumption as appropriate given the very long-term nature of the pension promises and the budgetary needs of plan sponsors. It should be noted that while the investment return assumptions have been slow to decline in recent years, they were also slow to rise with increases in the capital market assumptions. The typical public pension fund has used a discount rate between 7% and 9% for the last few decades, while long-term bond yields have ranged from 3% to 14% and projections for equity returns have also varied widely. See the following chart for a comparison of a typical fund's investment return assumption versus the expected return from the capital market assumptions.

If the investment return assumption changed as much or as rapidly as the capital market assumptions, the calculated contribution rates for funds would change rapidly from year to year and this could inhibit the goal of providing intergenerational equity. On the other hand, if the median investment rate calculated is accurate, then using a discount rate above that rate means that the plan is more likely to suffer actuarial losses than gains, which would result in higher contributions in future years more likely.

Expected Return Based on Capital Market Assumptions (Sample Retirement System)

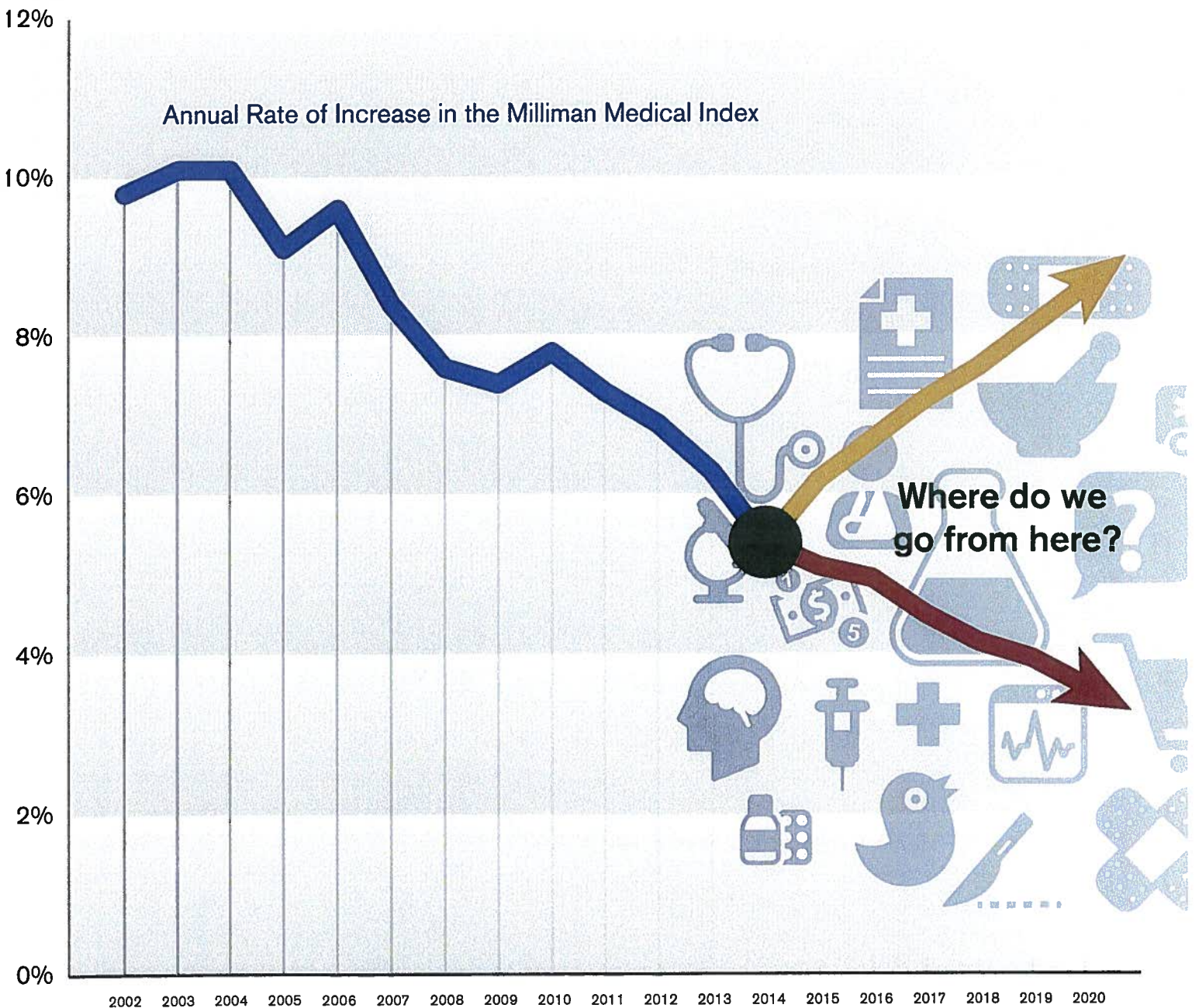


Conclusion

In compliance with GASB standards, the overwhelming majority of public pension funds base their discount rate on the expected investment returns of the fund. These rates are set through a combination of a model based on the capital market assumptions of investment advisors and a desire to take a long-term view. Assumptions have been declining in recent years and we expect this trend to continue as the rates implied by the capital market assumptions have dropped substantially. This will result in higher contributions in the short term. However, if the investment return assumption is not being reduced in accordance with the capital market assumptions, contributions in future years are likely to be higher than otherwise.



2014 Milliman Medical Index





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Components of cost	3
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EXECUTIVE SUMMARY

\$23,215. That's how much is spent in 2014 on healthcare for a typical American family of four covered by an average employer-sponsored health plan according to the 2014 Milliman Medical Index (MMI).¹ And yet while the amount has more than doubled over the past 10 years, growing from \$11,192 to \$23,215, the 5.4% growth rate from 2013 to 2014 is the lowest annual change since the MMI was first calculated in 2002.

Employers pay the largest portion of healthcare costs, contributing \$13,520 per year, or 58% of the total. However, increasing proportions of costs have been shifted to employees. Since 2007, when the economic recession began, the average cost to employers has increased 52%—an average of 6% per year—while the expenses borne by the family, through payroll deductions and out-of-pocket costs, have grown at an even faster rate, 73% (average of 8% per year).

Throughout this report we review the various components of the cost increases, how they are shared between employers and employees, and what key drivers are most likely to affect healthcare costs in 2014 and beyond.

Key findings

As measured by the 2014 MMI, the total annual cost of healthcare for a typical family of four covered by an employer-sponsored preferred provider plan (PPO) is \$23,215 (see Figure 1). Key observations are:

- The MMI has more than doubled over the past 10 years (107% increase from 2004 to 2014), growing from \$11,192 in 2004 to \$23,215 in 2014.
- Although healthcare costs continue to rise, the overall annual rate of increase in the cost of care for the family of four is at its lowest level since we first calculated the MMI in 2002. During those years, the annual increase in cost ranged from a high of 10.1%, in both 2003 and 2004, to a low of 5.4% in 2014. The rate of increase dropped by nearly a full percentage point, from 6.3% in 2013 to 5.4% in 2014. As discussed later in this report, this significant decline was likely due to a confluence of forces rather than any single event.
- In almost every year of the past 10, growth rates have decelerated. Figure 2 shows the most recent five years of that deceleration.

FIGURE 1

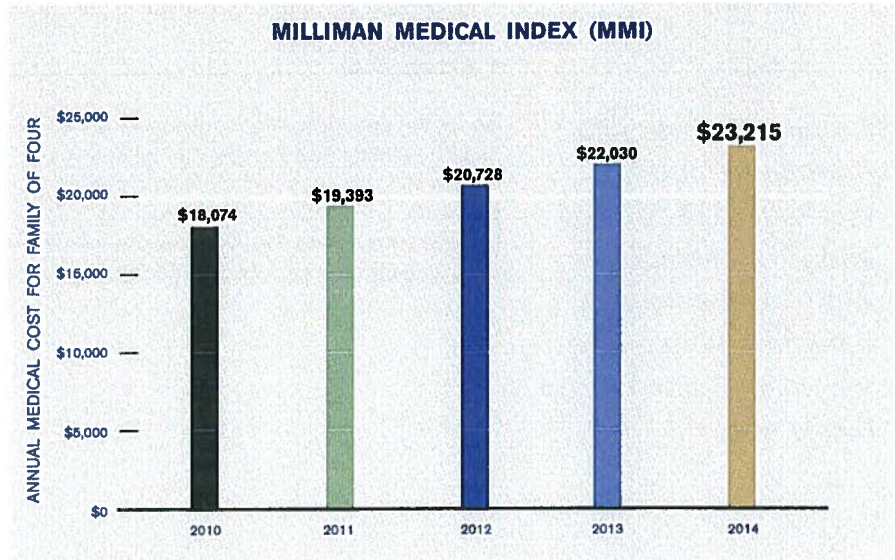
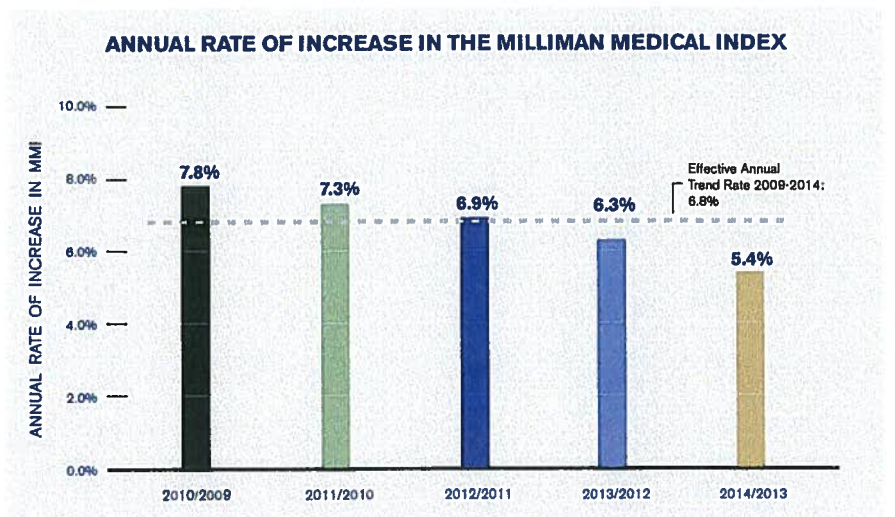


FIGURE 2



¹ The Milliman Medical Index is an actuarial analysis of the projected total cost of healthcare for a hypothetical family of four covered by an employer-sponsored preferred provider organization (PPO) plan. Unlike many other healthcare cost reports, the MMI measures the total cost of healthcare benefits, not just the employer's share of the costs, and not just premiums. The MMI only includes healthcare costs. It does not include health plan administrative expenses or profit loads.

- In each of the past four years, employees have assumed an increasing percentage of the total cost of care. The total employee cost (payroll deductions plus out-of-pocket expenses) increased by approximately 32% from 2010 to 2014, while employer costs (premium contributions) increased by 26%.

Although the annual rate of increase is down, it is still well above the rate of growth in the consumer price index (CPI).

Although the annual rate of increase is down, it is still well above the rate of growth in the consumer price index (CPI).² However, when and how future annual rates of increase will continue to change is unclear, and may depend on a number of factors such as:

- The economy
- Supply and demand influences
- Healthcare provider engagement in cost control
- Specialty pharmacy
- Transparency

So far, the emerging reforms required by the Patient Protection and Affordable Care Act (ACA) have had little direct impact on the cost of care for our family of four.

So far, the emerging reforms required by the Patient Protection and Affordable Care Act (ACA) have had little direct impact on the cost of care for our family of four in 2014 because this family tends to be insured through large group health plans. Some of the most far-reaching reforms are focused on access to insurance in the individual and small employer markets. Additionally, while the reforms are having immediate impacts on premium rates in those markets (the individual market, in particular), it is unclear whether they will ultimately have meaningful effects on growth in the cost of healthcare services.

² Over the 10-year period from 2004 through 2014, CPI has increased by approximately 2.3% per year, while the MMI has average annual increases of 7.6%.

COMPONENTS OF COST

The MMI examines the cost of healthcare under five separate categories of services:

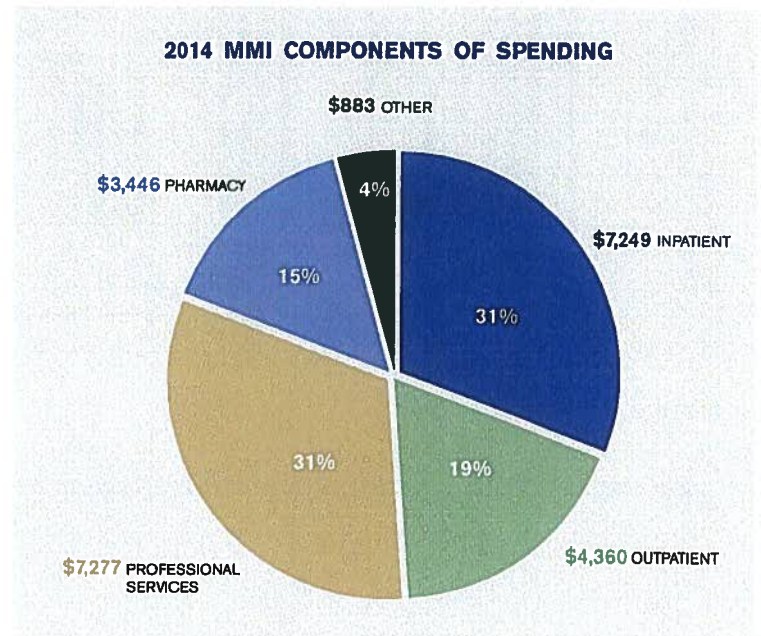
- Inpatient facility care
- Outpatient facility care
- Professional services
- Pharmacy
- Other services

As shown in Figure 3, for the MMI family of four, care provided by physician and other professional services accounts for 31% of the total spending.³ Inpatient and outpatient facility care account for 31% and 19% of the total, respectively, while pharmacy costs represent 15% of the total cost of healthcare for our family of four. The “Other” category of healthcare spending is the 4% of care that doesn’t fall into one of the other four categories. It includes such things as durable medical equipment, miscellaneous supplies, ambulance, and home health.

At \$7,249 in 2014 (see Figure 4 on page 4), inpatient facility costs grew by 5.7% (see Figure 5 on page 4), a rate similar to the 5.4% total growth rate for all services combined. Notably, inpatient hospital utilization rates, as measured by total days in the hospital, increased slightly. Over the previous five years, annual increases in inpatient utilization have averaged just below zero, meaning that utilization decreased slightly during that time. The utilization uptick may be one sign of a recovering economy, as people opt for procedures that they postponed during times of greater economic uncertainty. It may also be due, in part, to the “wearing off” of one-time utilization reductions resulting from implementation of hospital performance incentives, such as the readmission penalty program that the ACA established for Medicare patients. Although the MMI measures employer health plan costs, not Medicare costs, there are spillover effects from the high-volume Medicare patient population that affect how commercial and other patients are treated as well.

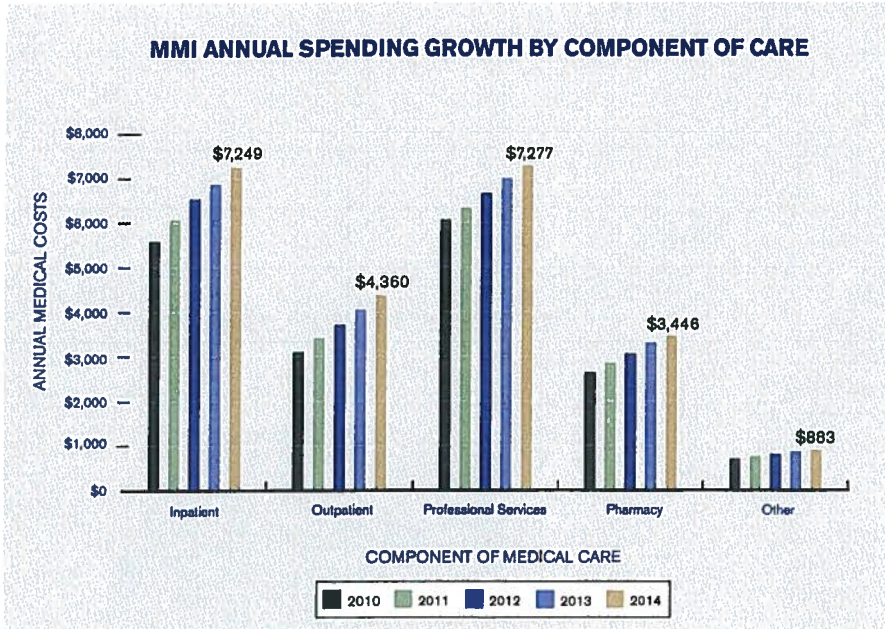
In recent years, increases in outpatient facility costs have also moderated. In 2014, outpatient facility costs increased 8.0%, down from an average of 9.9% over the previous five years. Much of the decline in outpatient facility cost growth has been attributable to slower growth in average costs per service. In the past it was common for health plans to contract with hospitals such that they would be paid a percentage discount from billed charges (e.g., a 30% discount from the hospital’s normal billed charges). In its simplest form, that method does not control the growth rate in average costs per service, because hospitals have some discretion in how much they increase their billed charge amounts. Increasingly, however, health plans are contracting using methods that more effectively control unit costs. Such methods include paying fixed case rates for services such as emergency room services or MRIs, or defining rates according to some benchmark that tends to grow more slowly, such as Medicare allowable fee levels.

FIGURE 3



3 As it has in prior MMIs, the professional services category includes doctors, physician assistants, nurse practitioners, chiropractors, hearing and speech therapists, physical therapists, and other clinicians.

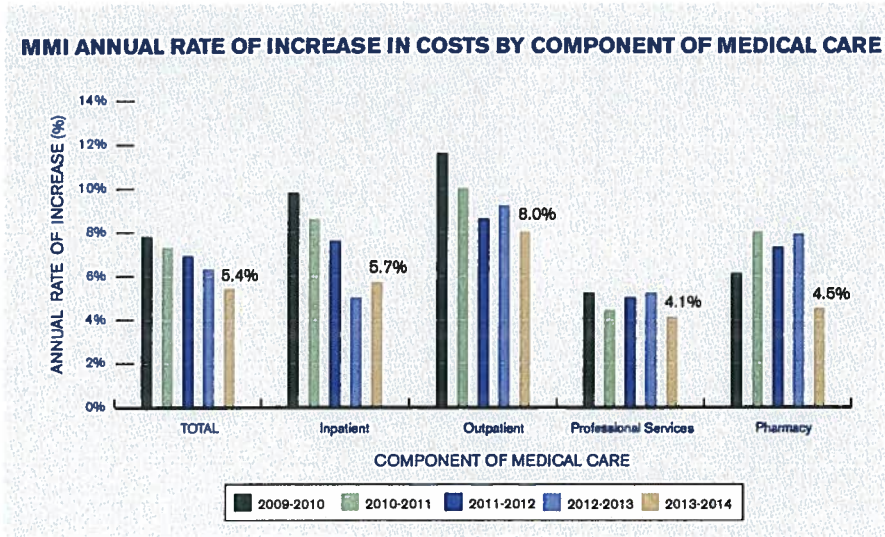
FIGURE 4



The 2014 increase in physician costs and other professional services was 4.1%. This is somewhat lower than the 5.2% average over the previous five years. In most years, including 2014, approximately 1% of the increase has been due to utilization increases (more services delivered, per person). The rest of the 4.1% is due to increases in average cost per service. Part of the average cost per service increase is a result of changes in the mix of services. For example, when local practice patterns change and expensive procedures, such as colonoscopies, are shifted from outpatient hospital departments into physician offices, it tends to affect the average cost per service in both treatment settings.

Pharmacy costs for the MMI family of four increased 4.5% over 2013. The shift of utilization from brand-name drugs to generics continues, but at a slower pace than in past years. Recently there have been fewer new brand-name drugs, and the patents have expired on several existing brand-name drugs, resulting in more prescriptions moving to generic. Pharmacy benefits also have somewhat limited protection from annual price increases, like hospital charges as discussed earlier in this report section. The price that a health plan is willing to pay for a prescription drug is often contractually defined as a discount from average wholesale price (AWP), particularly for brand-name drugs, but those AWP amounts are outside the control of insurance companies.

FIGURE 5



EMPLOYEES' SHARE OF HEALTHCARE COSTS

The total cost of healthcare for the MMI family of four is shared by employers and employees. To clearly define each payment source, we use three main categories:

- **Employer subsidy.** Employers that sponsor health plans subsidize the cost of healthcare for their employees by allocating compensation dollars to pay a large share of the cost. The portion paid by the employer typically varies according to the benefit plan option that the employee selects.
- **Employee contribution.** Employees who choose to participate in the employer's health benefit plan typically also pay a substantial portion of costs, usually through payroll deductions.
- **Employee out-of-pocket cost at time of service.** When employees receive care they also often pay for a portion of these services via health plan deductibles and/or point-of-service copays. While these payments are capped by out-of-pocket maximums as legislated by the ACA,⁴ these costs are still material to the employee.

The MMI is unique in that it measures only healthcare costs rather than insurance premiums, which would include loads for a health plan's administrative expenses, taxes, and profit. Premiums exclude out-of-pocket costs at time of service that are borne entirely by employees. To form a complete picture, the MMI includes these out-of-pocket costs as a component of the total healthcare spending.

Figure 6 shows the relative proportions of the three categories we track annually. Employers continue to subsidize their employees' healthcare costs by paying an average of 58% of the total cost of healthcare in 2014. Of the \$23,215 medical cost for a typical family of four, the employer pays about \$13,520 while the employee pays the remaining \$9,695, which is a combination of \$5,908 in employee payroll deductions and \$3,787 in out-of-pocket costs when they utilize medical services.

FIGURE 6

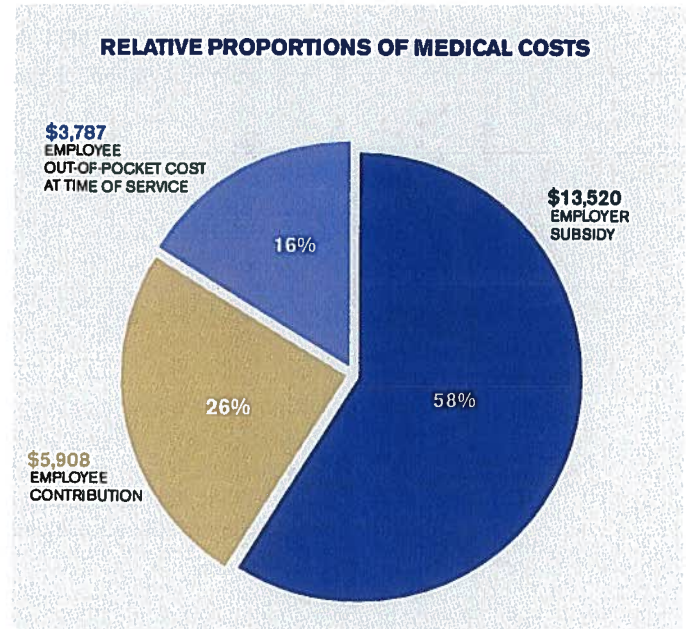
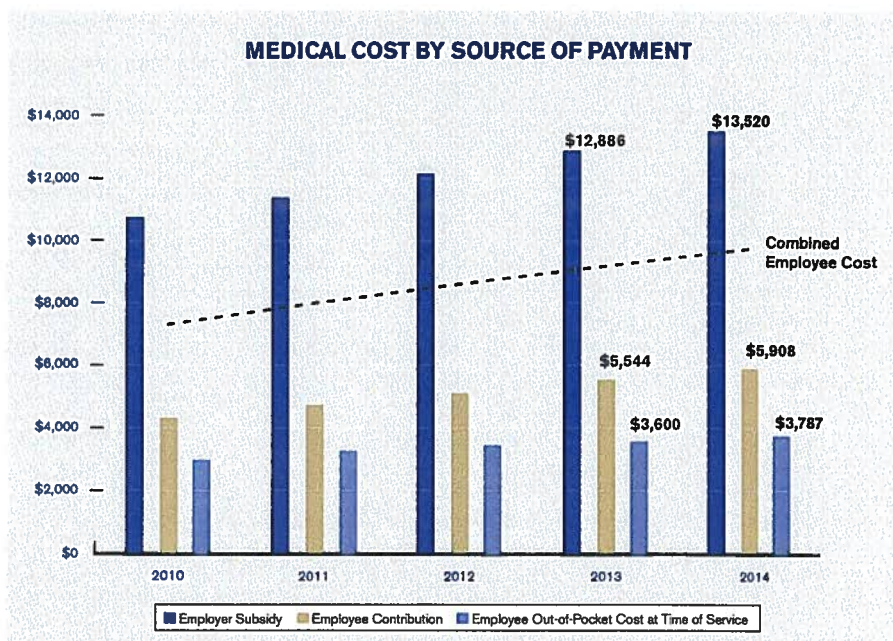


FIGURE 7

Employee costs (combined employee contributions and out-of-pocket costs) increased by 6.0% in 2014. This year's increase is less than in prior years (6.5% in 2013 and 7.2% in 2012). This good news for employees is offset by the fact that employees continue to bear more of the overall healthcare spending, according to the MMI—rising from 40.6% in 2010 to 41.8% in 2014.

Figures 7 and 8 illustrate how cost sharing has evolved over time. Employers adjust benefits each year in line with their healthcare budget constraints. In 2014, employers assumed \$633 of the total increase in the cost of care for the family of four. Employees saw a dollar increase of \$552 (\$365 from increased payroll deductions and \$187 from more out-of-pocket expenses). The employees' 6.0% increase is comprised of a 5.2% increase in employee out-of-pocket costs and 6.6% increase in payroll deductions. In other words, while both employer and employee costs increased, the employee experienced a larger percentage increase.



4 Out-of-pocket maximums for 2014 must not exceed \$6,350 per person and \$12,700 per family.

FIGURE 8

ANNUAL INCREASE IN SPENDING SPLIT BY EMPLOYER AND EMPLOYEE PORTIONS					
	2010/09	2011/10	2012/11	2013/12	2014/13
TOTAL MEDICAL COST (EMPLOYER & EMPLOYEE)	7.8%	7.3%	6.9%	6.3%	5.4%
EMPLOYEE OUT-OF-POCKET COST AT TIME OF SERVICE	6.6%	9.2%	5.8%	3.7%	5.2%
EMPLOYEE CONTRIBUTION	8.0%	9.3%	8.2%	8.4%	6.6%
EMPLOYER SUBSIDY	8.0%	6.0%	6.7%	6.1%	4.9%

The ACA introduced the concept of “metallic levels” for benefit plans starting in 2014. Individual and small group policies provided on the state exchanges must have a metallic level of “bronze” or higher; bronze implies that, on average, the plan will pay 60% of the costs for the essential health benefits (EHBs) that must be provided by the benefit plan. To help avoid penalties, larger employers must provide plans that, on average, pay at least 60% of the cost of covered services, a threshold deemed “minimum value.” The MMI plan has an actuarial value of approximately 83.7%.

In addition to a typical PPO plan, many employers offer their employees other plan options. A common alternative to a PPO is a “consumer-driven option” that includes higher out-of-pocket cost sharing. In return, many employers contribute to a health savings account (HSA) or a health reimbursement arrangement (HRA) and otherwise incentivize employees to participate in these plans as part of a larger effort to promote greater cost awareness by patients. For more on consumer-driven health plans, see the sidebar below.

Consumer-driven health plans and the MMI

The annual Milliman Medical Index measures the total cost of healthcare for a typical family of four covered by a preferred provider plan. Because 72% of firms offer some form of consumer-driven health plan (CDHP)—with 22% of employers planning to implement a total replacement CDHP in 2013**—many people ask how the MMI would change for a family of four covered by one of these plans instead of a PPO. Here we begin to answer some of those questions.

Employee out-of-pocket. Employees typically pay more at the point of service with CDHPs because deductibles and other cost-sharing features are often higher versus the MMI PPO plan.

Employee contribution. Payroll deductions are often lower for CDHP plans. In some instances, employers set a fixed defined contribution that is the same for all plans offered. Since CDHP premiums are lower cost than other plans, this results in a lower payroll deduction.

Employer contribution to CDHP account. The accounts paired with CDHPs offer a way to save for future expenses that the typical PPO does not. Keep in mind that, on average, employees will use a good portion of the contribution made by their employers on plan cost sharing for deductibles and coinsurance. However, employees that use few healthcare services and/or regularly invest in these accounts can accumulate meaningful amounts to be spent on future healthcare expenses on a pre-tax basis.

Total cost of care. CDHPs tend to have higher deductibles than other plans, which encourages lower utilization of services, and therefore yields lower total healthcare costs.

Milliman will publish additional research on typical costs for a family of four covered by a CDHP later this year.

** National Business Group on Health (August 28, 2013). Large U.S. Employers Project a 7% Increase in Health Care Benefit Costs in 2014, National Business Group on Health Finds. Accessed May 15, 2014, at <http://www.businessgrouphealth.org/pressroom/pressRelease.cfm?ID=214>

COMPARING HEALTHCARE COSTS UNDER PPO VS. CDHP COVERAGE

	PPO	CDHP
EMPLOYEE OUT-OF-POCKET	\$3,787	↑
EMPLOYEE CONTRIBUTION	\$5,908	↓
EMPLOYER SUBSIDY	\$13,520	DEPENDS
EMPLOYER CONTRIBUTION TO CDHP ACCOUNT	NA	↑
TOTAL COST OF CARE (MMI)	\$23,215	↓

DRIVERS OF ANNUAL COST INCREASE

While costs increased at a slower rate in 2014, it is a difficult challenge to isolate the exact drivers of the phenomenon, given the number of changes going on in healthcare.

The economy

The slow economy has influenced healthcare spending in recent years. For our family of four, annual cost increases have been held at bay due to less income being available for discretionary healthcare spending and reduced provider investment. History tells us that an improvement in the U.S. economic environment will give an upward push to annual healthcare cost increases. However, experts disagree on the strength of the current economic recovery and when it will begin to exert upward pressure on healthcare costs. This year's MMI assumes that the recovery will have limited effect on healthcare costs in 2014, with the cost pressure lagging behind economic improvement. Additionally, some recent one-time impacts are likely to persist even after the economy recovers, such as large employers' actions to reduce costs through higher cost sharing and reduced spousal and family coverage.

Supply/demand influences

While the ACA may not have a significant direct impact on the employer group market measured by the MMI, changes to other markets are likely to have ripple effects. The expansion of coverage through Medicaid and the exchanges could increase demand for healthcare services. Some of that demand will be short-term, due to pent-up demand for services, but more critically, the long-term demand will probably be higher as a greater percentage of the U.S. population has health insurance coverage. This greater demand for services will put pressure on supply, possibly leading to higher provider reimbursement rates and costs. A systemic increase in utilization could crowd out our typical family of four from receiving certain services, thereby impacting their utilization. We may also see cost shifting to the employer group market because the reimbursement rates tend to be lower in the markets that are expanding; on the other hand, insurers' negotiations with providers for the exchange market may push down the rates across all lines of business. Finally, some providers may be willing to accept lower rates than in the past, perhaps due to a reduction in uncompensated care for the uninsured. The interactions are complex, and the impacts are likely to vary by geographic area.

Healthcare provider engagement in cost control

Increased provider engagement in cost control has helped keep annual cost increases down in recent years. In some cases there may have been one-time cost decreases, such as the reduction in hospital readmissions that is due to changes to Medicare reimbursement policies; other payment reforms may have implications in 2015 and beyond. Provider organizations are becoming more accustomed to risk-taking and looking for efficiencies through clinical integration, thereby influencing costs throughout the system.

While many of the payment reform programs, such as accountable care organizations (ACOs) and bundled payment models, have been introduced in the Medicare program (and to a lesser extent in Medicaid), they have spillover effects for all payors. Use of these models is expected to expand in future years, and may continue to influence future annual cost increases as the more effective models become permanent parts of the healthcare delivery and financing systems.

Specialty pharmacy

Specialty drug utilization rates are increasing. Specialty drugs are currently used by a small percentage of people to treat such conditions as hepatitis C, multiple sclerosis, cystic fibrosis, and cancer, but their costs are extremely high. Medicare defines a specialty drug as one that costs more than \$600 per month, but many specialty drugs cost much more.

History tells us that an improvement in the U.S. economic environment will give an upward push to annual healthcare cost increases. However, experts disagree on the strength of the current economic recovery and when it will begin to exert upward pressure on healthcare costs.

Increased provider engagement in cost control has helped keep annual cost increases down in recent years.

Increased transparency of pricing and expected out-of-pocket costs will ensure that patient costs are a part of the purchasing decision, which has not historically been true in healthcare when people are covered by relatively rich benefit plans.

The act of being able to sort available plans by price will ensure that consumers can act in their own economic self-interest while also motivating health insurance companies to offer affordable plans.

Transparency

Costs may be pressured downward as healthcare delivery and purchasing becomes more transparent. Key examples of this include:

Consumerism. The consumerism movement is about engaging consumers to maximize value in their healthcare purchases. Value may be defined in terms of cost, quality, choice, or other metrics. Increased transparency of pricing and expected out-of-pocket costs will ensure that patient costs are a part of the purchasing decision, which has not historically been true in healthcare when people are covered by relatively rich benefit plans. With the excise “Cadillac” tax coming online in 2018, some employer plans that have traditionally been very rich have begun to shift toward leaner plans—resulting in a more meaningful opportunity to participate in the consumerism movement.

Premium rate filing transparency. Individual and small group premium rates—and in some states, large group rates—must be submitted to insurance regulators for review and approval. Those rate filings are increasingly publicly available and the requested rate increases, particularly for large carriers, often end up in the newspaper. The heightened public scrutiny may accentuate existing efforts to keep premium rate increases low. While premium rates include loads for carrier administrative expenses and profit, which are not included in the MMI, most of a premium (usually 80% to 90%, or more) pays for healthcare expenses.

Product homogenization. The ACA has made plan comparability a high priority in the individual and small group markets through introduction of metallic-level benefit richness requirements, and it has simplified comparison shopping in all markets by prohibiting dollar-based benefit limits, setting limits on out-of-pocket maximums, introducing minimum value standards, and imposing other requirements that affect all commercial health insurance plans.

Exchanges. Health insurance exchanges facilitate transparency and comparison of products. The act of being able to sort available plans by price will ensure that consumers can act in their own economic self-interest while also motivating health insurance companies to offer affordable plans. Over time, we expect this to affect large group plans as well. For more information, see the sidebar on private exchanges below.

How we balance our competing desires to have the best care, freedom of choice, cost control, and appropriate rewards for innovation, investment, and positive patient outcomes will steer future healthcare cost trends up or down. Creative solutions will be needed. The ACA may have planted some seeds that will ultimately bear fruit through increased transparency, experimentation with provider risk taking, and focus on outcomes such as through the new Patient Centered Outcomes Research Institute. As these efforts mature, we may begin to see what effects they will have on healthcare costs. And we will see whether additional (and possibly paradigm-changing) innovations will still be needed.

Private exchange movement and the MMI

What is a private exchange?

A private exchange is a virtual marketplace, similar to the individual and small group health insurance exchanges established by the ACA. However, the private exchanges are developed by employer coalitions, employee benefits consulting firms, or other entities, and are primarily intended to serve large employer groups.

Why are employers interested in private exchanges?

Private exchanges can provide flexible one-stop shopping solutions for employers and employees to purchase a variety of benefits, including health insurance, life insurance, and other ancillary insurance products. Multiple carriers may participate in the exchanges, providing variety of choice and facilitating price competition through transparency and through competitive bidding by carriers for the opportunity to sell in

the exchange. The exchanges also help employers implement defined contribution approaches where they contribute a fixed amount per employee. Employees can then choose from any benefit plan offered in the exchange and contribute their share of the health insurance premium with pre-tax dollars.

How will private exchanges impact health care costs and trends?

Whether the private exchange movement will have any material effect on the overall cost of care tracked by the MMI is uncertain. Time will tell if the improved transparency and ease of comparison among products and prices will help to control healthcare costs. For more information on private exchanges, reference our library of private exchange publications.*

* www.healthcaretownhall.com/?p=7466

TECHNICAL APPENDIX

The Milliman Medical Index (MMI) is made possible through Milliman's ongoing research in healthcare costs. The MMI is derived from Milliman's flagship health cost research tool, the Health Cost Guidelines™, as well as a variety of other Milliman and industry data sources, including Milliman's MidMarket Survey.

The MMI represents the projected total cost of medical care for a hypothetical American family of four (two adults and two children) covered under an employer-sponsored PPO health benefit program. The MMI reflects the following:

- Nationwide average provider fee levels negotiated by insurance companies and preferred provider networks
- Average PPO benefit levels offered under employer-sponsored health benefit programs⁵
- Utilization levels representative of the average for people covered by large employer group health benefit plans in the United States

Variation in costs

While the MMI measures costs for a typical family of four, any particular family or individual could have significantly different costs. Variables that impact costs include:

Age and gender. There is wide variation in costs by age, with older people generally having higher average costs than younger people. Variation also exists by gender. Our MMI-illustrated family of four consists of a male age 47, a female age 37, a child age four, and a child under age one. This mix allows for demonstration of the range of services typically utilized by adult men, women, and children. Average utilization and costs of specific services will be different for other demographic groups.

Individual health status. Tremendous variation also results from health status differences. People with severe or chronic conditions are likely to have much higher average healthcare costs than people without these conditions.

Geographic area. Significant variation exists among healthcare costs by geographic area because of differences in healthcare provider practice patterns and average costs for the same services. For example, the relative cost of living affects healthcare costs, as labor costs (e.g., nurses and technicians) tend to be higher in areas where the cost of living is higher. Access to advanced technology also affects the utilization of services by geographic area.

Provider variation. The cost of healthcare depends on the specific providers used. Even in the same city, costs for the same service can vary dramatically from one provider to another. The cost variation results from differences in billed charge levels, discounted payment rates that payors have negotiated, and implementation of payment methodologies that may influence utilization rates, such as capitation or case rates.

Insurance coverage. The presence of insurance coverage and the amount of required out-of-pocket cost sharing also affects healthcare spending. With all other variables being equal, richer benefit plans usually have higher utilization rates and costs than leaner plans.

For further perspective on how the Milliman Medical Index fits in the evolving healthcare system, visit our blog at:

[www.healthcaredownhall.com/
?tag=milliman-medical-index](http://www.healthcaredownhall.com/?tag=milliman-medical-index)

⁵ For example, for 2014 average benefits are assumed to have an in-network deductible of \$725, various copays (e.g., \$131 for emergency room visits, \$29 for physician office visits, \$11/18%/28% for generic/formulary brand/non-formulary brand drugs), and coinsurance of 18% for non-copay services, etc.



Milliman is among the world's largest providers of actuarial and related products and services. The firm has consulting practices in healthcare, property & casualty insurance, life insurance and financial services, and employee benefits. Founded in 1947, Milliman is an independent firm with offices in major cities around the globe. Learn more at milliman.com.

Appendix C

Sample Audit Report

***Actuarial Audit of the
State Teachers
Retirement System
of Ohio***

Submitted To:

Ohio Retirement Study Council

By:

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CONFIDENTIAL

November 6, 2009

Ohio Retirement Study Council
88 East Broad Street, Suite 1175
Columbus, OH 43215

Ladies and Gentlemen:

We are pleased to present the enclosed report summarizing our findings and recommendations resulting from our independent review of the actuarial methods, procedures, and actuarial assumptions and the resulting actuarially computed contributions and liabilities as shown in the July 1, 2008 Actuarial Pension Valuation report for the State Teachers Retirement System of Ohio (STRS), and the January 1, 2009 Actuarial OPEB Valuation report for STRS.

This report presents an executive summary followed by separate sections discussing in detail our findings, analyses and recommendations. While some issues are discussed at greater length than others, this report is intended to provide a complete and independent third party review of STRS and its operations from an actuarial perspective. All comments and recommendations are intended to be constructive. Our purpose was to identify areas of possible improvement in the system, its operation and/or the actuarial procedures.

We would like to thank the staffs of PricewaterhouseCoopers LLP, "PwC" and of the Retirement System for their cooperation. Their prompt and courteous responses to our questions and requests for information were of valuable assistance to us and greatly appreciated.

In preparing this report, we have relied on the census data and asset information provided by STRS and PwC. We have not audited or verified this data and other information beyond the testing described in this report. If the data or information is inaccurate or incomplete, the results of this report may likewise be inaccurate or incomplete.



Unless otherwise noted, the actuarial assumptions and methods used in this report are those developed by PwC for STRS. The plan provisions utilized were based on the 2008 actuarial valuation, Revised Code Chapter 3307, and the STRS member handbook, with clarifying information from STRS' staff.

Differences between our projections and actual amounts depend on the extent to which future experience conforms to the assumptions used in this report. It is certain that actual experience will not conform exactly to the assumptions used in this report. Actual amounts will differ from projected amounts to the extent that actual experience deviates from expected experience.

This report has been prepared for the internal use of ORSC and STRS, and is only to be relied upon by these entities. We consent to the distribution of this report as provided under the contract for this work. No portion of this report may be disclosed to any other party without Milliman's prior written consent. In the event such consent is given, the report must be provided in its entirety.

Milliman's work product was prepared exclusively for the use or benefit of ORSC and STRS for a specific and limited purpose. It is a complex, technical analysis that assumes a high level of knowledge concerning STRS' operations, and uses data provided by STRS and PwC, which Milliman has not audited. Any third party recipient of Milliman's work product who desires professional guidance should not rely upon Milliman's work product, but should engage qualified professionals for advice appropriate to its own specific needs.

I am a member of the American Academy of Actuaries and meet its Qualification Standards to render this actuarial opinion.

I look forward to having the opportunity to present this report and respond to questions regarding our review and recommendations.

Respectfully submitted,

Glenn D. Bowen, FSA, EA, MAAA

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ORSC_2008_Audit.doc



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**Actuarial Audit of the
State Teachers Retirement System of Ohio**

This report was prepared solely to provide assistance to ORSC. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Milliman recommends that any third party recipient of this report be aided by its own actuary or other qualified professional when reviewing the Milliman report.

EXECUTIVE SUMMARY AND RECOMMENDATIONS

This report summarizes the results of an actuarial review of the State Teachers Retirement System of Ohio, "STRS". The purposes of this review are:

- to determine if the data, assumptions and methods are accurate, appropriate and reasonable for funding the benefits promised, and
- to verify through a full replication of the valuation that the data, assumptions and methods were applied accurately.

Overall Assessment

Our overall assessment as a result of our review of PwC's actuarial work for STRS is that all major actuarial functions are being appropriately addressed. PwC has employed generally accepted actuarial practices and principles in studying plan experience, selecting assumptions, computing employer contribution rates, and presenting the results of their work.

Review of Another Actuary's Work

In a system as large and complex as STRS, there are many operational aspects that have a bearing on the actuarial analysis of the plan. The reader should recognize that many of the issues that we reviewed and which we will discuss in this report are subject to opinion and professional preference. No two actuaries (or actuarial firms) are likely to use precisely the same methods and assumptions (and, therefore, arrive at precisely the same conclusions) when presented with the exact same problem and set of historical facts. In completing our review, we have attempted to focus on those aspects of the plan and its actuarial functions that could be meaningfully improved. In presenting our findings in this report, we have tried to limit discussion of aspects which reflect our professional preferences but which would have minimal effect on the results and conclusions presented by the actuary.

By its nature, a review of another professional's work product will tend to focus on those aspects where the reviewer believes some modification in current procedures would be desirable. Hence, a report such as this will devote the vast majority of the presentation to criticism that, even though intended to be constructive, may give the reader the impression that only problems were found. ***Therefore, we would like to state clearly up front that we found the actuarial procedures and practices to be of a high quality and in compliance with all major aspects of the applicable actuarial standards.*** While we will discuss several areas where we believe some modifications in current data collection procedures, actuarial assumptions or methods would be beneficial, that discussion should be considered within the context of an overall favorable report concerning PwC's work.



EXECUTIVE SUMMARY AND RECOMMENDATIONS

Actuarial Valuation Model

STRS is a complex retirement system, offering a Defined Benefit Plan, a Defined Contribution Plan and a Combined Plan with varying contribution rates, accrual rates, actuarial equivalent factors, and optional forms of benefits that members may elect upon retirement.

It is important to note that the actuarial valuation is based on a model that estimates benefits expected to be paid in the future. The determination of the liabilities and contributions are then based on those projections. During this modeling, some estimates or approximations may be made by the actuary due to immateriality, inadequate data, or complexity. The use of such estimates or approximations is generally accepted within the actuarial profession.

A purpose of this audit is to review the valuation model to determine if the results are reasonable and the assumptions, estimates and approximations appropriate. We recommend consideration of several changes in the model that will, in our opinion, improve its "accuracy". But overall, we believe that the results presented by PwC in the July 1, 2008 and January 1, 2009 Actuarial Valuation Reports are reasonable and appropriate for the intended uses of those reports.

Recommendations

Set forth below are our five major recommendations for possible changes in current procedures resulting from our review. Four would affect the determination of the System's liabilities and costs and the fifth would affect future Actuarial Experience Reviews.

Recommendation #1: Post-retirement Mortality Assumption

As discussed in *Section III – Actuarial Valuation Assumptions*, actuarial standards indicate that the mortality assumption used in determining pension obligations should provide appropriate margin for future mortality improvements. This can be done either by specifying a "static" mortality table with a margin built in (e.g. – a mortality assumption that generates fewer expected deaths than has occurred in the recent past), or by specifying a "projected" mortality table (e.g. – starting with a mortality assumption that matches current mortality rates and projects annual decreases in mortality rates into each future year modeled in the valuation). PwC used a static mortality table in the July 1, 2008 valuation of STRS. Based on our review of the mortality assumption, we find some age/gender combinations that appear to allow a reasonable margin for future improvement in mortality, while other age/gender combinations that have a negative margin (i.e. – the assumption anticipates a *greater* number of expected deaths than indicated by recent experience). We recommend that the mortality assumption be



EXECUTIVE SUMMARY AND RECOMMENDATIONS

revised to provide sufficient margin across all age and gender combinations, and thus in total.

Recommendation #2: Investment Return Assumption

As discussed in *Section III – Actuarial Valuation Assumptions*, we believe that, while the STRS current investment return assumption complies with the requirements of Actuarial Standard of Practice No. 27 (ASOP27), *Selection of Economic Assumptions for Measuring Pension Obligations*, that 8.0% is in the optimistic end of the acceptable range as specified in ASOP27. We believe that a net rate of return assumption of 7.5% will provide an unbiased or more neutral estimate of future returns over the period during which STRS will pay benefits to the current participants. We recommend that STRS consider reducing the current 8.0% investment return assumption.

Recommendation #3: Reflection of Contribution Timing

As discussed in *Section III – Actuarial Valuation Methods and Procedures*, we recommend that the calculation of the Normal Cost Rate be revised to better reflect the actual timing of the receipt of contributions to the System. Currently, this Rate is determined by dividing (a) the amount of the normal cost for the coming plan year by (b) the prior year annualized salaries of active members included in the Actuarial Valuation increased by one-half of a year's assumed payroll growth. The dollar amount of the normal cost for a plan year is being determined as if it would be paid at the beginning of the plan year. Since contributions are received on a monthly basis throughout the plan year, with an average receipt at mid-year, we recommend that the dollar amount of the normal cost applied to determine the Normal Cost Rate be increased by one-half year of interest to reflect this delay in the receipt of contributions after the beginning of the plan year. Also, the prior year annualized salaries used to determine this rate are being increased by one-half year of payroll growth to approximate the payroll upon which contributions will be made. Based on our understanding that teachers' pay increases occur predominantly at the beginning of the school year, we recommend increasing the prior year annualized salary by a full year of payroll growth to better reflect the expected payroll in the upcoming plan year.

Recommendation #4: Service in Multiple Systems

As discussed in *Section I – Data Validity*, in our review of individual member benefit calculations provided to us by the System versus valuation data provided by the System to the actuary for the valuation, we identified one transferred member whose actual benefit calculation was based on service and pay with both OPERS and STRS, but whose valuation liability was based only on the service and pay within STRS. The result was a significant understatement of this member's liability. Due to the large number of members who have earned service in more than one of the five Ohio



EXECUTIVE SUMMARY AND RECOMMENDATIONS

Retirement Systems, we recommend that STRS compile information from the other Ohio Retirement Systems regarding active and inactive members who have service in one or more of those systems and provide information to PwC so that all service and pay may be taken into account in the valuation of such members.

Recommendation #5: Presentation of Proposed Actuarial Assumptions

As discussed in *Section III – Actuarial Valuation Assumptions*, when conducting an experience review, the actuary will tabulate the actual number of occurrences of a particular decrement over the study period, and will compare the actual number of decrements with the number expected based on a combination of the prior census data and actuarial assumption. Dividing the actual occurrences by the expected occurrences results in an actual to expected ratio (“A/E ratio”). Deviations in actual versus expected results (e.g. – A/E ratios above or below 1.0) provide a basis for the actuary to modify assumptions prospectively. Once a new assumption is proposed it is possible to calculate A/E ratios for the prior period as if the new assumption had been in place during the prior period. Calculating A/E ratios on the proposed new assumption is a powerful way to review the appropriateness of the new assumption. We recommend that PwC include A/E ratios in future experience review reports based on both the prior and the proposed new assumptions in order summarize the extent to which the new assumption matches actual experience relative to the prior assumption. Please see our discussion of post-retirement mortality in Section III for more detail.

Impact of Milliman Recommendations

We are not in a position to quantify the potential impact of reflecting the increased liability for members who have service in more than one Ohio retirement system. For the first three recommendations above, we have estimated the impact on the funding period of reflecting each recommendation and have estimated the increased contributions needed to fund the incremental liability on a 30 year basis.

Scenario	Funding Period (years)	Change in Funding Period (years)	Change in ARC as % of Payroll (on 30 year funding basis)
July 1, 2008 valuation report	41.2	--	--
Reflect post-retirement mortality recommendation only	68.9	27.7	1.64%
Reflect investment return recommendation only	infinite	infinite	4.08%
Reflect contribution timing recommendation only	44.1	2.9	0.24%



EXECUTIVE SUMMARY AND RECOMMENDATIONS

The "Change in ARC as a % of Payroll" shown in the far right column is the amount of additional contributions needed to fund the incremental normal cost and unfunded liability attributable to that change on a 30 year basis. It is in addition to the 1.46% of payroll that would be needed to fund the System on a 30-year basis using the results in the July 1, 2008 valuation report. For example, increasing the contribution rate by 1.46% of payroll would reduce the 41.2 year funding period shown in the report to 30 years, and an additional 1.64% of payroll, for a total increase of 3.10% of payroll, would be needed to satisfy the 30-year funding requirement if Milliman's mortality assumption recommendation was adopted.

Please note that the combined impact of adopting more than one of these recommendations would be greater than the arithmetic sum of the results shown above.

Response from STRS and System Actuary

Upon completion of our draft audit report, Milliman requested that STRS and PricewaterhouseCoopers review our report to advise us of any misinterpretations that we may have made in conducting our audit. In conjunction with their review, STRS and PricewaterhouseCoopers provided us with a letter that documented their responses to the five recommendations above. We thank STRS and PricewaterhouseCoopers for their review, and have included the response letter on the following page.



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OF OHIO

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October 30, 2009

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RETIREMENT BOARD CHAIR
MARK H. MEUSER

RETIREMENT BOARD VICE CHAIR
TIM MYERS

EXECUTIVE DIRECTOR
MICHAEL J. NEHF

Dear Mr. Bowen:

We have received and reviewed the draft report for the actuarial audit of STRS Ohio dated October 16, 2009. STRS Ohio greatly appreciates your significant time and effort in preparing the report and recommendations. Milliman's assessment that actuarial procedures and practices are of high quality and in compliance with applicable actuarial standards provides valuable assurance to the STRS Board as well as the Ohio Retirement Study Council.

Representatives of PricewaterhouseCoopers and the STRS Ohio staff have reviewed the recommendations in the draft report and offer the following responses. We hope you will consider including this information in your final written report.

Recommendation #1 Post-retirement Mortality Assumption

STRS Ohio agrees that adjusting the mortality assumption to include a margin for future mortality improvements may be appropriate. We believe this recommendation will best be considered in conjunction with the next scheduled actuarial experience review in 2013.

Recommendation #2 Investment Return Assumption

STRS Ohio agrees that its current investment return assumption of 8% may be on the "... optimistic end of the acceptable range ..."; however, it is consistent with the results of an asset allocation study completed by Russell Investment Group and adopted by the Retirement Board in May 2009. According to that report, the mean average 20-year rate of return for STRS Ohio's current asset allocation is 8.1%, including 0.4% return from active management. STRS Ohio has added value from active management over the past twenty years. Moreover, a recent Public Fund Survey conducted by the National Association of State Retirement Administrators and the National Council on Teacher Retirement found that the median investment return assumption for the public funds surveyed is 8%. STRS Ohio will continue to monitor its ability to meet the long-term investment return assumption through periodic asset allocation/liability studies, along with the advice and recommendations of the Retirement Board's investment and actuarial consultants.

(continued)

Recommendation #3 Reflection of Contribution Timing

STRS Ohio and PwC agree that revising the calculation of the Normal Cost Rate to better reflect timing of contributions is appropriate and will take it into consideration for future actuarial valuations.

Recommendation #4 Service in Multiple Systems

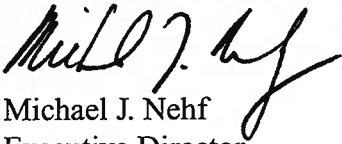
STRS Ohio agrees that including actuarial data for individuals participating in more than one Ohio public retirement system is desirable. However, the refinement in calculating accrued pension liabilities may be relatively small compared to the administrative cost and effort needed to collect and compile the data. While Ohio's public retirement systems regularly cooperate in a variety of projects, sharing active member data is complicated by different fiscal years, varying procedures for collecting contributions and determining service credit, and compatibility of information systems. Additionally, it may not be clear in any given year which retirement system will ultimately pay a person's benefit. STRS Ohio will explore the feasibility of sharing joint member data with other Ohio retirement systems.

Recommendation #5 Presentation of Proposed Actuarial Assumptions

STRS Ohio agrees that actual to expected ratios for proposed new assumptions may be useful and will request this information in the next actuarial experience review scheduled for 2013.

Thank you for the opportunity to review a draft copy of your report. Your conclusion that all major actuarial functions are being appropriately addressed, along with recommendations for improvement, is greatly appreciated.

Respectfully,



Michael J. Nehf
Executive Director

SECTION I – DATA VALIDITY

Background

The member data used by the actuary is one of the basic foundations of an actuarial valuation. It forms the basis for actuarially projecting the benefits provided to members by STRS. Thus an important step in an actuarial audit is reviewing the validity of the member data.

To perform this task, we requested the data STRS provided to PwC for the July 1, 2008 valuation and additional information from STRS regarding members who retired after July 1, 2008. After reviewing this data we then requested thirty individual benefit calculations from STRS that were randomly selected to encompass a wide variety of the benefits STRS members receive. These benefits include service retirement benefits, disability benefits, survivor benefits, and lump sum options in the DB, DC, or Combined Plans. Twenty of the requested calculations were for members whose benefits commenced subsequent to July 1, 2008 (they were reported as active members on the valuation date) and ten of the requested calculations were for members whose benefits commenced prior to July 1, 2008 (they were reported as inactive members on the valuation date).

We requested copies of the actual benefit calculations. This allows us to compare the data that was used to determine the member's benefit (which was presumably subject to careful review by STRS) with the data provided for the actuarial valuation. STRS indicated that it would be very difficult to provide copies of the actual benefit calculations. Instead, they provided the data used to calculate the member's benefit for all thirty requested calculations summarized in a spreadsheet format. Later, we requested and were provided copies of actual benefit calculations for two specific members out of the group of thirty members. This information was the basis for our review.

The purpose of reviewing actual benefit calculations is two-fold. First, we reviewed the benefit calculations for reasonableness, consistency and compliance with the Legislative Code governing STRS as well as the STRS Member Handbook. Second, we reviewed the data used in the benefit calculations for consistency with the valuation data provided to the plan actuary for the July 1, 2008 valuation.

Benefit Calculation Review

For all 30 of the calculations we reviewed, the benefits were computed accurately based on the member data provided to us and were reasonable and consistent with the Legislative Code.



SECTION I – DATA VALIDITY

For the 10 members who retired prior to the valuation date, we also found that the benefit chosen by the member was accurately reflected in the data supplied to the actuary.

For 19 of the 20 calculations for members who began receiving benefits subsequent to July 1, 2008, we found that the final data used for the benefit calculations was reasonably related to the data that had been supplied to the actuary.

In our experience, this degree of matching indicates that high quality data is being provided to the actuary by the System.

However we did note for one member that the Final Average Salary and Total Service used in the actual benefit calculation were \$84,898 and 24.02 years, respectively, and the Final Average Salary and Total Service in the data supplied to the actuary for the July 1, 2008 valuation were \$61,893 and 13.21 years, respectively. STRS informed us that the service difference was due to the member having transferred service from OPERS. In addition, the high earnings used in determining the Final Average Salary were from past years with OPERS. These differences produced a substantial understatement in the member's liability in the valuation.

Recommendation

Based on the data provided by the five Ohio Retirement Systems for the *Report Regarding Service Purchases* dated March 14, 2007 to the Ohio Retirement Study Council, roughly 700 members in other retirement systems transfer service into STRS in a typical year and 500+ members transfer service from STRS to another system in a typical year. (FY 2005 was considered to be a typical year when that report was prepared.) Thus there are a significant number of such transfers each year. Since these transfers increase the number of years of service of the member, in some circumstances the additional service may significantly accelerate the date when the member can retire and the level of health insurance subsidy for which they are eligible in addition to increasing the amount of pension payable to them.

As a result, we recommend that all five of the Ohio Retirement Systems consider the feasibility of identifying members who have service credits under more than one system and share relevant information (e.g., service, earnings, accumulated contributions) regarding those members with the actuary for each system in which that member has participated. If this data were compiled and provided to each of the actuaries, it could be reflected in the annual actuarial valuations for each of the five systems. We also note that there are other types of additional service credits that increase a members' liability, such as purchases of military service or out-of-state service, and we recommend that all such service credits be provided to the actuary for inclusion in the valuation.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Plan Provisions

To the extent possible, we compared the plan provisions used in the valuation programming with the Revised Code Chapter 3307 governing STRS, the Summary Plan Descriptions provided to members, and to the actual retirement calculations described in Section I. We were not provided with “individual test lives” from PwC due to the proprietary nature of their calculations, therefore our review of the detailed programming for the valuation was conducted through correspondence/discussions with PwC. Based on this review, we believe the plan provisions are being applied in the valuation programming in a reasonable and appropriate manner.

Data Editing

In preparing an actuarial valuation, the actuary will review the “raw” data provided by the plan sponsor, and will “edit” the data as needed to complete missing data and/or to remove discrepancies. We requested and received a copy of the edited data from PwC.

Based on our understanding of the data provided to the actuary, we reviewed the data procedures employed by PwC to review the reasonableness of interpretations, estimates and adjustments made in the data editing process. PwC provided us with the following brief explanation of their data editing process:

Our data editing methodology consists of two phases. The first phase considers if the data provided for the current year is consistent with the data provided for the prior year. The second phase considers if the data provided for the current year is internally consistent and reasonable.

A sample of the checks performed in phase 1 is as follows:

- Account for the movement of members valued in prior year*
- Check that increases in service fields are reasonable*
- Check that increases in salary fields are reasonable*
- Reconcile account balances from prior year to current year*
- Reconcile retiree benefit amounts from prior year to current year*
- Check that dates of birth unchanged from prior year*

A sample of the checks performed in phase 2 is as follows:

- Service amounts reasonable relative to hire date field*
- Dates of birth reasonable and consistent with status field*
- Salaries data reasonable*
- Account balances reasonable relative to service and salary fields*
- Disability types consistent with hire date*

Given the size and complexity of the data, we do not seek to resolve every issue for every member. Rather we attempt to ensure that there are no systemic issues that affect the data on a large scale.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Overall, we found PwC’s procedures to be reasonable and appropriate for the scope of the project and consistent with Actuarial Standard of Practice 23 - *Data Quality*.

Data Grouping

As commonly done when conducting valuations of large public employee retirement systems, PwC applies a data grouping process to the individual data records to reduce the number of records that must be run through the valuation program. When grouping data, individual records that contain similar characteristics (age, service, salary, benefit amount, form of payment, etc.) are combined into a “grouped” record that will produce an actuarial liability approximately equal to that of the sum of the individual records. We requested and received a copy of the grouped data from PwC.

We found the process used by PwC to group the data to be generally reasonable and appropriate. However, we did find that in PwC’s grouping process for the active data, the salary for males and females with similar demographic characteristics is averaged together. This averaging produced a \$190 million difference in the allocation of male and female total annual salary in the individual active census data versus the grouped active census data. The differences are shown below for both the DB plan and the Combined plan.

DB Plan	Active Count	Total Annual Salaries on Individual Data	Total Annual Salaries on Grouped Data	Difference
Male	48,500	2,837,339,524	2,649,315,538	(188,023,986)
Female	120,514	6,176,798,333	6,364,822,312	188,023,979
Total	169,014	9,014,137,857	9,014,137,850	(7)

Combined Plan	Active Count	Total Annual Salaries on Individual Data	Total Annual Salaries on Grouped Data	Difference
Male	926	41,416,352	38,655,521	(2,760,831)
Female	3,387	132,008,013	134,768,842	2,760,829
Total	4,313	173,424,365	173,424,363	(2)

PwC indicated that they do process the individual data through their valuation system to assure that their grouping methodology does not bias the liability results significantly. We similarly ran the individual data through our system to determine if this methodology produces reasonable results. Our individual census data valuation run produced liabilities that were approximately 0.06% lower than the grouped data valuation run, which indicates that PwC’s grouping methodology did not bias the liability results of the July 1, 2008 valuation.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Asset Valuation Method

The asset valuation method is a four-year smoothed market value of assets that spreads the difference between the actual investment income and the expected income (based on the valuation interest rate) over a period of four years. The actuarial value of assets is also limited to a minimum of 91% and a maximum of 109% of market value. We find that this method is reasonable and consistent with the guidance provided in Actuarial Standard of Practice 44 - *Selection and Use of Asset Valuation Methods for Pension Valuations*.

General Observations on Procedures

In this section we discuss several observations that focus on the interrelationships between the procedures, methods and assumptions applied in the valuation, and between the measurement of assets and obligations.

Inactive Members – Refund Only

For inactive members that are only due a refund of their member contributions, PwC is using the sum of the member's contribution account plus the 50% employer matching account as the accrued liability for valuation purposes. Presumably, all of the inactive members due a refund only have less than five years of service and would not receive the 50% matching account. We believe PwC's method may slightly overstate this portion the liability, but feel that it is a reasonable estimate considering these inactive members may not be immediately receiving their refund and have left their contributions in the fund accruing interest. Moreover, some of these members may return to active service in the future.

Inactive Members – Eligible for Annuity

For inactive members eligible for a monthly allowance, PwC assumes that 50% of these members will eventually elect to receive a monthly annuity benefit and that 50% will elect to receive their member's contribution account plus the 50% employer matching account immediately. Without any detailed experience information to suggest otherwise, we feel this is a reasonable approach to determining the liability for these members. But it may be appropriate to consider modifying this assumption so that members who do not request a refund within a few years of termination be considered more likely to ultimately receive a monthly annuity benefit than members who have recently terminated as active members.

SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Money Purchase Benefit

Our understanding is that PwC does not value the Money Purchase Benefit for inactive members eligible for a monthly allowance. Members who terminated active membership many years prior to retirement eligibility may receive a significantly larger benefit under the Money Purchase provision than either the normal formula benefit or the refund of member's contribution account plus the 50% employer matching account. Therefore we suggest that PwC consider modifying their valuation programs so that the Money Purchase Benefit provision is taken into account for inactive members assumed to ultimately receive an annuity benefit.

Disability Allowance Plan

The benefit for currently disabled members in the Disability Allowance Plan converts to a service retirement benefit at age 65. PwC does not reflect this change in their valuation coding. We believe this is a reasonable approach as the cost effect of this change in benefits at age 65 should be de minimis.

Reemployed Retirees

For retirees that are reemployed, PwC is using two times the member's contribution account as the accrued liability for valuation purposes. We believe this is a reasonable approach to determining the liability for these members.

Plan Election – Option to Transfer to DB Plan after 5 Years

STRS allows new members to choose between three plans, the Defined Benefit Plan, the Combined Plan and the Defined Contribution Plan. When members who initially selected the Combined Plan or the DC Plan reach 5 years of service, they must permanently elect to remain in those plans or they will transfer to the Defined Benefit Plan. This chance to reconsider the initial election after 5 years is a valuable option for a member, in that unfavorable investment experience during the initial membership period in the Combined or DC Plan can be expected to encourage the member to move to the DB Plan when they reach 5 years of service.

An option such as this is difficult to measure using traditional actuarial procedures for valuing pension plans. PwC does not currently make any special provision to account for the potential cost. The value of this option to transfer to the DB Plan would be expected to increase during periods of adverse investment market conditions. To roughly test the potential additional liabilities associated with this option, we estimated the potential increase in the unfunded actuarial accrued liabilities if all of the active members in the Combined Plan with less than 5 years of service as of the July 1, 2008



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

valuation date transferred to the DB plan. We found that the impact would be only a few million dollars of increased liability. Given that, and since less than 100% of these members are likely to transfer, we find that the cost of this option is currently insignificant with respect to the total System's liability.

The potential cost of this option is low in part because relatively few new members join the Combined or DC Plans. In the event that a larger portion of members start to elect coverage in those plans, or a choice to rejoin the DB plan is offered after a greater amount of service has elapsed, it is possible that the cost of this option could become material.

Actuarial Cost Method

Both the pension and retiree healthcare valuations use the entry age actuarial cost method to determine the cost of benefits accrued during the upcoming year (known as the normal cost) plus the value of benefits accrued for all years of past service (known as the accrued liability) as of the valuation date. The normal cost and accrued liability are the basis for determining the Normal Cost Rate and the Accrued Liability Rate. We find that the actuarial cost method used in both the pension and retiree healthcare valuations is reasonable and consistent with the guidance provided in Actuarial Standard of Practice 4 - *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*.

Determination of Contribution Requirements

Pension Plans

The current contribution rates to STRS total 24%, which comprises a 10% member contribution rate and a 14% employer contribution rate. The Board allocates the total contribution rate between pension benefits and health care benefits. Currently, 1% is allocated toward health care, leaving 23% for pension benefits. To determine the remaining funding period for STRS, contributions are first allocated to the Normal Cost, with any remainder allocated to amortize the Unfunded Accrued Liability. Using the remaining rate that is allocated to the Accrued Liability, an effective remaining amortization period can be determined. This is the expected number of years remaining to pay off any unfunded liabilities of the plan. Using the figures provided in the valuation report, we can reproduce PwC's determination of the Accrued Liability Rate of 8.76% and the effective unfunded liability amortization period of 41.2 years.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Although the use of the cost method is sound overall, we believe that the following two adjustments should be made in the calculation of the Normal Cost Rate:

- 1) The numerator used to calculate the Normal Cost Rate is the “dollar normal cost” payable as of the beginning of the plan year. However, since the employer and member contributions are received on a monthly basis throughout the year, these amounts are not all in the fund earning interest as of July 1. We believe that the dollar normal cost in the numerator of the Normal Cost Rate should be increased by one-half of a year's interest to reflect that on average, contributions are received at mid-year.
- 2) The denominator used to calculate the Normal Cost Rate is the expected payroll during the plan year on which contributions will be made. PwC's development of the expected payroll for the upcoming plan year is based on increasing the prior year's annualized salaries by one-half year of payroll growth. This would be appropriate if raises occurred throughout the year, or on average at mid-year. However for a teachers' retirement system, we believe that a more accurate approach would be to increase the prior year's annualized salary by a full year of payroll growth based on the expectation that salary raises occur predominantly at the beginning of the year.

This revised procedure would increase the Normal Cost Rate by 0.24% of payroll. Such an increase in the Normal Cost Rate would decrease the amount of the overall contribution that remains to be allocated to paying down the unfunded liability. Thus it would increase the funding period reported in the Actuarial Valuation by 2.9 years, from 41.2 years to 44.1 years.

Retiree Healthcare Plan

Using the figures provided in the valuation report, we can reproduce PwC's determination of the Accrued Liability Rate of 4.09%. Based on similar reasoning to that described above, we believe the numerator of the Normal Cost Rate should be increased with one-half year of interest at the valuation rate of 4.9% and the denominator of the Normal Cost Rate should be increased with one-half year of payroll growth (4.5% for the 2008-09 plan year, varying rates thereafter).

SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Selection of Actuarial Assumptions

Choosing actuarial assumptions is highly subjective. It is unlikely that any two actuaries, given the same set of experience statistics, would arrive at exactly the same set of actuarial assumptions for any system as complex as STRS. Even allowing for the minor variations that occur because of the variability of the underlying statistics and possible data anomalies, differences among actuarial approaches will occur in analyzing trends. Some actuaries prefer to match the results of recent experience very closely in setting future assumptions, while other actuaries will use recent experience as a guide but tend to change existing assumptions gradually over time. Valid arguments can be made for either approach.

In many cases of statistical analysis, the greater the volume of data analyzed the more reliable the results. This is not necessarily true in evaluating the experience of the members of a retirement system if this involves extending the study over long periods of time. For example, consider mortality experience. Twenty years ago the mortality rates at each age were considerably higher than the corresponding rates of mortality in more recent years. Thus to include the experience of twenty years ago in a mortality study would produce rates of mortality higher than are currently being experienced and can be expected to be experienced in the future. The use of mortality rates from these prior periods could understate life expectancy and, hence, costs.

We will comment on the demographic and the economic assumptions used in the July 1, 2008 valuation and will make suggestions for future experience studies below.

Information Provided

We were provided with copies of:

- a PowerPoint presentation, *Five Year Experience Review July 1, 2003 – June 30, 2008*, dated November 20, 2008 by PricewaterhouseCoopers (“the PwC PowerPoint”); and,
- a report, *Experience Review for the period July 1, 2003 to June 30, 2007*, dated April 7, 2008 by Buck Consultants (“the Buck Report”).

Demographic experience data tabulations for the fiscal year 2007-08 were not included in the actuarial experience data provided to us, although that data was evidently reflected in the PwC PowerPoint. Hence our detailed analysis was primarily based on the 4-years of experience data tabulations as summarized in the Buck Report.

In the PwC PowerPoint and the Buck Report, we found the methodology and analysis to be generally in accordance with common actuarial techniques. In the PwC PowerPoint, only general descriptions of the recommendations by PwC were provided, such as “reduce retirement rates”. So we used the detailed summaries of the new assumptions



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

appearing in the July 1, 2008 actuarial valuation report to evaluate the new assumptions. Of course, the presentation of the PwC PowerPoint undoubtedly included oral comments that we were not privy to.

We suggest future presentations and reports show the effect of the recommendation on the particular assumption being studied. One common method for displaying this effect is to show actual to expected ratios (“A/E ratios”) based on the recommended rates in addition to the current rates. A/E ratios are a common way to display the percentage of actual decrements to the expected decrements. An A/E ratio greater than one indicates that there were more actual decrements than expected and an A/E ratio less than one indicates there were less actual decrements than expected. A/E ratios were displayed for the current assumptions throughout the Buck Report and we suggest, for comparison purposes, such A/E ratios be applied for the recommended new assumptions as well.

Demographic Assumptions

Overview

We found that the general methodologies used to prepare the experience study were appropriate and that the assumptions developed generally comply with the guidance provided by Actuarial Standard of Practice No. 35 *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*.

The ultimate purpose of any actuarial experience study is to provide a basis for setting the actuarial assumptions for future valuations. We are satisfied that the statistical analysis undertaken in the presentation and the resulting recommendations of PWC are reasonable.

Presentation of Results

We found the data tabulations summarized in the Buck Report very helpful in analyzing the results of the experience review, and recommend that PWC present similar summaries of the data tabulations when they prepare the next experience review. As stated earlier, expanding the data tabulations to provide A/E ratios based on the proposed new assumptions would help users better understand the extent of the assumption changes being recommended.

Salary Increases

For the next experience review, we suggest reviewing increases in salaries by length of service rather than solely by age. In our experience, service (possibly combined with age) may be a better indicator of salary increases than solely age. For example, the



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

rate of salary increases provided to members who recently joined the system between ages 40 and 50 may be significantly larger than the increases provide to members the same age who joined 20 or more years ago. Separating long service members from newly hired members when tabulating experience data would allow consideration of this alternative approach for structuring the salary growth assumption. Reflecting the impact of members' service on salary increases may improve the accuracy of the estimated liabilities and cost of the system.

Withdrawal

The withdrawal assumption is split into members terminating prior to completion of 5 years (non-vested terminations) and subsequent to the completion of 5 years (vested terminations). For the next experience review, we suggest tabulating the data into smaller groups to see if there are significantly different rates of termination within each of these categories. For example, terminations among very short service members is often much higher than terminations among members with 3 or 4 years of service. Reflecting such differences, if they exist, in the actuarial assumptions may improve the accuracy of the estimated liabilities and cost of the system.

Annuitant Mortality Assumption

Mortality rates have been decreasing (life expectancy has been increasing) for several centuries, and this trend has continued in recent years. As a result, *ASOP 35 – Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations* and the *Society of Actuaries Retirement Plans Experience Committee* recommend that actuaries make provision in their assumption regarding annuitant mortality for the likelihood of continued improvements in the future. We are concerned that the new mortality assumption for service retirees may not adequately provide for such continuing improvements in mortality.

The Buck Report indicates that there were significantly fewer deaths among service retirees than anticipated by the prior actuarial assumption regarding service retiree mortality. As a result, PWC proposed a new service retiree mortality assumption that significantly reduced the number of expected deaths. As indicated earlier, PWC did not present data in the PwC PowerPoint indicating the A/E ratio (actual to expected ratio) based on the proposed new assumption. So we estimated the A/E ratio for the new service mortality assumption, based on the data shown in the Buck Report. We have summarized below the resulting estimates.

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Estimated Actual to Expected Ratios for the Proposed New Service Retiree Mortality Assumption

Average Age	Males			Females		
	Actual Deaths	Estimated Expected Deaths	A/E Ratio	Actual Deaths	Estimated Expected Deaths	A/E Ratio
55	41	70	59%	44	52	85%
60	170	189	90%	154	185	83%
65	256	304	84%	287	375	77%
70	410	444	92%	397	521	76%
75	647	620	104%	677	730	93%
80	900	787	114%	893	898	100%
85	773	682	113%	1,399	1,237	113%
90	529	472	112%	1,777	1,435	124%
Over 92	312	277	113%	1,938	1,509	129%
Total	4,038	3,844	105%	7,566	6,941	109%

Based on these estimates, we are concerned that the mortality rates among males 75 and under and among females 85 and under may be too high; i.e., they assume that more service retirees will die at these ages than indicated by actual recent experience. Moreover, we believe that the 5-year data is statistically significant since the number of deaths over the entire 5-year experience study period totals roughly 5,000 male deaths and 10,000 female deaths (note, we were not provided data for the fifth year, fiscal 2007-08).

At ages 80 and above among males and 85 and above among females, the proposed new service retiree mortality assumption anticipates fewer deaths than indicated by recent experience, which provides some margin for future improvement in longevity at those ages. But at younger ages, we are concerned that the proposed new assumption may not adequately provide for future life expectancies among young service retirees, nor for current active members who will retire in the future.

In order to estimate the potential impact on the long-term cost of STRS of modifying the service retiree mortality assumption to fully reflect recent experience and to allow for future improvements in mortality, we developed an alternative service mortality assumption. We did so by developing a table that roughly replicated the actual mortality experience summarized in the 4-year Buck Report for each age group, and then used the projection scale AA developed by the *Society of Actuaries Retirement Plans Experience Committee* to make provision for future mortality improvements. (Note we would have preferred to use the experience data for the entire 5-year study period, but we did not receive the final year's data, fiscal 2007-08.)



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Our analysis indicates that the adoption of a modified service retiree mortality assumption that reflects actual recent experience and makes provision for future mortality improvements based on the recommendation of the Society of Actuaries could increase the Unfunded Actuarial Accrued Liability by approximately \$2.3 billion, and the Annual Required Contribution based on a 30-year funding period by approximately 1.64% of payroll.

Disabilities among Active Members

We noticed that the data tabulations shown for the active member disabilities in the Buck Report improperly compared the number of active member disabilities among members with five or more years of service with the number of all active members including those with less than five years of service. PwC confirmed that Buck had made its analysis on that basis. PwC indicates that for 2007-08 it properly compared the number of active member disabilities among members with five or more years of service with the number of active members including only those with five or more years of service. Unfortunately when PwC did the analysis presented in the PwC PowerPoint, they did not recognize the mistake in Buck's tabulations for the four-year period from 2003 to 2007 when they were creating tabulations for the combined 5-year period. As a result, the disability rates among active members are understated by roughly 40%. We believe this is a de minimis issue since disability represents a small amount of the overall liability and since members who would otherwise be projected to exit service due to disability are simply reallocated to another decrement (withdrawal, retirement, death) and benefit therein.

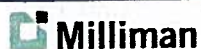
Economic Assumptions

Overview

We found that the general methodologies shown in the PwC PowerPoint and the Buck Report were appropriate and that the assumptions developed generally comply with the guidance provided by Actuarial Standard of Practice No. 27 *Selection of Economic Assumptions for Measuring Pension Obligations*.

Investment Return

Milliman develops long-term capital market expected returns based on current yields and valuation levels, published surveys of expert forecasts of real GDP growth and inflation, and historical risk measures of asset class return volatility and covariance. These capital market assumptions underlie the "building block" method used in our expected return based on the guidance in Actuarial Standard of Practice No. 27 (ASOP27), *Selection of Economic Assumptions for Measuring Pension Obligations*. The building block method in our model considers asset allocation, expected return and



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

variance of each class, and correlation and covariance between asset classes. We then analyze the output ranges and adjust for expected investment expenses in order to arrive at our recommended investment return assumption.

The expected geometric mean return from the building block method does not change based on the compounding period under consideration, however the expected range of results around the mean shrinks significantly as the time frame is increased. The following table shows Milliman's expected 25th, 50th and 75th percentile returns for a 1 year, 20 year and a 75 year period.

Expected Investment Returns for various time horizons prior to reflecting expenses			
	1 year period	20 year period	75 year period
75 th percentile return	16.50%	9.52%	8.58%
50 th percentile return	7.58%	7.58%	7.58%
25 th percentile return	(0.64%)	5.69%	6.60%

The percentile return refers to the likelihood that we expect the actual return over the period to be less than the stated result, for example over a 20 year period we expect that the return will be less than 5.69% in 25 out of 100 cases.

Due to the long-term nature of the pension obligation, we look to the results compounded over a 75 year period to recommend an investment return assumption for valuation purposes. The current 8.0% assumption is in the middle of the third quartile of our results for a 75 year period, and thus we view this assumption as somewhat optimistic over a very long time horizon (e.g. – it is somewhat more likely that investment losses will occur in the future as opposed to investment gains relative to the 8.0% long-term return assumption). We believe that an assumption of 7.5% would better reflect expected investment returns net of plan expenses and provide a more neutral, or unbiased, expectation of future results.

Our analysis indicates that the adoption of a 7.5% net return assumption could increase the Unfunded Actuarial Accrued Liability by approximately \$5.3 billion, and the Annual Required Contribution based on a 30-year funding period by approximately 4.08% of payroll.

OPEB Assumptions

Many of the assumptions used in the pension valuation are also used in the valuation of other postemployment benefits (OPEB). Three additional assumptions used in the January 1, 2009 OPEB valuation are discussed below.



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Healthcare Trend

The Society of Actuaries (SOA) has recently developed a Long-Run Medical Cost Trend Model that can be applied in the development of medical trend schedules used in projecting per capita claim costs and premiums in OPEB valuations. The model's baseline projections are based on an econometric analysis of historical US medical expenditures and the judgments of experts in the field, and the model can be modified for the particular plan being valued. We compared the results of the SOA model to trend rates used in the January 1, 2009 OPEB valuation, and find that there is a difference in the shape of the curve (the trend table used by PwC starts higher and grades to the ultimate rate very quickly whereas the SOA trend table starts lower but grades to the ultimate rate much more slowly) but only a minor difference in the cumulative projected cost increases. We believe the trend table applied in the January 1, 2009 OPEB valuation is reasonable and appropriate.

Investment Return

Under GASB 43, the investment return assumption is dependent on the funding of the plan. For OPEB plans that are on a path to full funding via the annual contribution of a GASB-compliant Annual OPEB Cost (AOC), the investment return assumption is based on the asset allocation in the same manner as for a pension fund. For OPEB plans that operate on a pay-as-you go basis, the investment return is based on the general assets of the plan sponsor. For OPEB plans that are being partially pre-funded (in excess of pay-as-you-go but less than the full AOC), the investment return assumption is blended to reflect the amount of pre-funding occurring.

The "full-funding" assumption used is 8.0%, the same rate for the pension plans. Please see our comments above on this rate. The "pay-as-you-go" rate used is 4.0%, which we believe is a reasonable rate for this purpose. The resulting blended rate of 4.9% based on the partial pre-funding is a reasonable result as well.

Election Rates

Not every member who is receiving a pension benefit will elect to participate in the retiree healthcare plan. We typically expect that election rates will decrease as contributions required of the retiree and/or spouse increase. Due to the recent effective date of GASB 43, the election rate assumption was reviewed at a high-level only. Based on our comparison of current in-pay membership counts in the pension and OPEB plans, we believe that the retiree coverage and the spousal coverage election rates used in the January 1, 2009 valuation are reasonable.



SECTION IV – ACTUARIAL VALUATION REPORT

We have reviewed the July 1, 2008 actuarial valuation report and offer the following suggestions for inclusion in future valuation reports.

Variability of Future Results

Pension plan management is a long-term proposition and the development of actuarial costs and liabilities is dependent upon a combination of the data, plan provisions, actuarial assumptions and actuarial methods employed in the valuation. The actuarial liabilities and costs are not meant to be precise results but rather best estimates that are within a reasonable range of results.

Actuarial Standard of Practice No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions* (“ASOP 4”), addresses this issue in Section 4, *Communications and Disclosures*. Per ASOP 4, actuarial communications should contain statements appropriate for the intended audience that indicate that future actuarial measurements may differ significantly from the current measurement. The following sample communication is provided in Section 4.1(l) of ASOP 4:

“Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law.”

We recommend that a similar communication be included in future actuarial valuation reports.

Summary of Plan Provisions

We have reviewed the summary of plan provisions contained in the actuarial valuation report and find that it is consistent with the Revised Code Chapter 3307 governing STRS. The report appropriately and concisely summarizes the many benefit provisions available to STRS members. We suggest that the summary of plan provisions in future valuation reports be expanded slightly to contain a description of the following plan provisions:

- a description of the Money Purchase Plan benefit available to members in the Defined Benefit plan, and
- a description of the Partial Lump Sum Option available to members in the Defined Benefit and Combined Plans.



SECTION IV – ACTUARIAL VALUATION REPORT

Summary of Actuarial Assumptions

We suggest that the summary of actuarial assumptions in future valuation report be expanded to include the following assumptions:

- The retirement rates used for the Combined Plan. The rates used are slightly different than those for the Defined Benefit Plan. The Combined Plan uses the rates for those under 25 years of service for all ages.
- The assumed form of payment election assumptions used for the various benefits for both the Defined Benefit and Combined Plans.
- The assumed number of dependents for the survivor benefit.

SECTION V – PARALLEL VALUATION

Our approach to performing a parallel valuation is two-fold. First, we calculate and compare actuarial calculations for selected individual sample members with those produced by the System actuary. Second, we run the full census data through our valuation software to compare overall valuation results. Below we discuss some important differences between the actuarial valuation programs used by PwC and Milliman, then we present the results of our parallel valuation.

Differences between PwC's and Milliman's Actuarial Software

Both the pension and retiree healthcare valuations use the entry age actuarial cost method to determine annual contribution requirements and the effective unfunded accrued liability funding period. Although actuaries are well versed in the standard actuarial cost methods available, there are differences in interpretation and implementation from firm to firm such that no two actuarial valuation software programs perform calculations exactly the same way. As shown below, the results of our parallel valuation are similar, however there are differences in PwC's and Milliman's software methodology affecting the normal cost and accrued liability calculations that give the appearance of discrepancies that may be misleading. Overall, we are comfortable that while the normal cost and accrued liability calculations produced by PwC's and Milliman's actuarial valuation software differ somewhat, the values produced by PwC are reasonable and comply with relevant actuarial standards. Discussed below are two specific differences in our software systems that make direct comparison of results difficult.

First, PwC's system applies decrements at the beginning of year, meaning that the assumptions used for withdrawal, retirement, disability, etc. are assumed to occur at the beginning of the valuation year. Milliman's system applies decrements at the middle of the year, assuming that participants terminate, retire, die, become disabled, etc. throughout the valuation year (or on average, at mid-year). Both approaches provide a reasonable basis for actuarial calculations and both are generally acceptable practices; the difference is one of "actuarial style." Milliman's actuarial software does not allow us to precisely emulate the beginning-of-year approach used by PwC, so this difference in approaches causes some differences in our results.

Second, the development of the entry age normal cost by each valuation system differs. PwC's system generates a level percentage of pay normal cost for each benefit that accrues only over the time period when that specific benefit could become payable. A simple example is that the liability for a refund of member contributions that occurs for members with less than five years of service is spread over only five years. Thus under PwC's methodology, the normal cost as a percentage of payroll will vary somewhat over the working lifetime of a member. On the other hand, Milliman's valuation system spreads the normal cost for all benefits over the member's entire career - from entry age to the final assumed retirement age. So referring back to the previous example,



SECTION V – PARALLEL VALUATION

Milliman's software would spread the normal cost associated with the refund of member contributions over the entire working career of the member, a much longer period of time for a young employee. Under our approach the normal cost rate as a percentage of payroll will remain constant over the member's working lifetime. Due to this difference in methodology, our valuation systems develop entry age normal costs that differ somewhat. Therefore, the results shown below should not be construed as suggesting an incorrect determination of the normal costs by PwC. We show them only to disclose the results of our attempt to replicate PwC's results. In our judgment, PwC's results are appropriate and reasonable.

Individual Sample Member Liability Calculations

As noted above, our approach involves first attempting to replicate the actuarial calculations for selected individual sample members. This allows us to understand the actuary's valuation programming on a micro basis and enables us to customize our valuation programming to perform similar calculations as much as possible. Unfortunately, PwC did not provide us with detailed individual sample member liability calculations due to the proprietary nature of their calculations. Thus we do not have as detailed an understanding of their calculations as we would prefer. PwC did provide us with total liability results for seven selected members. Based on the results of the full parallel valuation runs set forth below we believe that PwC has appropriately reflected all major benefits available to members of STRS, but since we could not test our calculations in detail at an individual member level it was difficult to determine where our differences might lie.

Full Parallel Valuation Runs - Pension

The following table compares the results of our parallel replication valuation of the Defined Benefit, Combined, and Defined Contribution Plans by various participant groups. PwC's figures are the present values as shown in the valuation report or as otherwise provided to us by PwC. Milliman's figures represent our replication of PwC's numbers using the census data as edited for valuation purposes and provided to us by PwC.

Milliman's figures should not replace the results reported in the Actuarial Valuation. Our calculations are appropriate only for actuarial review purposes and are not suitable for other purposes.

SECTION V – PARALLEL VALUATION

STRS Defined Benefit, Combined and Defined Contribution Plans
Comparison of Present Values as of July 1, 2008
(\$ Amounts in Thousands)

	<u>PwC Valuation</u>	<u>Milliman's Calculation</u>	<u>Percentage Difference</u>
<u>Active Defined Benefit Plan Members</u>			
Number	169,014	169,014	0.0%
Annualized Salaries	\$9,014,138	\$9,014,140	0.0%
Present Value of:			
Benefits	45,520,176	45,926,087	0.9%
Earnings	84,677,935	88,380,476	4.4%
Accrued Liability	33,413,339	32,799,398	-1.8%
Normal Cost Rate	14.23%	15.80%	11.1%
<u>Active Combined Plan Members</u>			
Number	4,313	4,313	0.0%
Annualized Salaries	\$173,424	\$173,424	0.0%
Present Value of:			
Benefits	165,758	159,534	-3.8%
Earnings	2,234,969	2,366,517	5.9%
Accrued Liability	58,083	55,792	-3.9%
Normal Cost Rate	4.96%	4.80%	-3.1%
<u>Inactive Members</u>			
Number	148,559	148,559	0.0%
Present Value of Benefits	\$1,459,523	\$1,451,244	-0.6%
<u>"In Pay" Members</u>			
Number	126,506	126,506	0.0%
Present Value of Benefits	\$51,874,103	\$51,794,267	-0.2%
<u>Reemployed Retirees</u>			
Number	21,467	21,467	0.0%
Present Value of Benefits	\$320,073	\$320,073	0.0%
<u>Defined Contribution Account Balances</u>	\$307,227	N/A*	0.0%
<u>Total</u>			
Present Value of:			
Benefits	\$99,646,860	\$99,958,432 **	0.3%
Accrued Liability	87,432,348	86,728,001 **	-0.8%

* We could not verify the DC account balances for members in the DC plan.

** Includes DC account balances from valuation report



SECTION V – PARALLEL VALUATION

Due to the difference in entry age normal cost development between PwC's and Milliman's valuation software described above, we believe that the best way to look at the results above is how close is our replication of the present value of future benefits (PVB). In total, we could replicate PVB in the valuation report within 0.3%. On subplan basis we only differ on PVB by more than one percent in the determination of the PVB for active Combined Plan members. Since the active Combined Plan PVB is a very small portion of the total PVB (less than 0.2% of total PVB), we did not see the need to investigate this particular difference any further with PwC.

In summary, since differences in actuarial values of 1% or more are possible solely due to differences in the underlying actuarial systems, we view the results above as a successful replication by Milliman of PwC's results.

Full Parallel Valuation Runs – Retiree Healthcare

The following table compares the results of our parallel replication valuation of the Retiree Healthcare Plan by various participant groups. PwC's figures are the present values as shown in the valuation report or as otherwise provided to us by PwC. Milliman's figures represent our replication of PwC's numbers using the census data as edited for valuation purposes and provided to us by PwC.

Milliman's figures should not replace the results reported in the Actuarial Valuation. Our calculations are appropriate only for actuarial review purposes and are not suitable for other purposes.

SECTION V – PARALLEL VALUATION

STRS Retiree Healthcare Plan
Comparison of Present Values as of January 1, 2009
(\$ Amounts in Thousands)

	<u>PwC Valuation</u>	<u>Milliman's Calculation</u>	<u>Percentage Difference</u>
<u>Active Members</u>			
Number	173,327	173,327	0.0%
Projected Membership Payroll	\$10,505,428	\$10,505,428 *	0.0%
Present Value of:			
Benefits	11,754,940	11,908,242	1.3%
Accrued Liability	6,700,202	6,791,655	1.4%
Normal Cost Rate	3.57%	3.86%	8.2%
<u>Inactive Members</u>			
Number	18,300	18,300	0.0%
Present Value of Benefits	\$132,765	\$81,482	-38.6%
<u>"In Pay" Members</u>			
Number	121,639	121,639	0.0%
Present Value of Benefits	\$6,580,756	\$6,279,894	-4.6%
<u>Total</u>			
Present Value of:			
Benefits	\$18,468,461	\$18,269,618	-1.1%
Accrued Liability	13,413,723	13,153,031	-1.9%

* We strictly used PwC's determination of projected membership payroll

As was the case with the pension plans, we believe that the best way to look at the results above is how closely we could replicate PVB. In total, we replicated PVB by within 1.1%. As discussed in the prior section, since differences in actuarial values of 1% or more are possible solely due to differences in the underlying actuarial systems, we view the results above as a successful replication by Milliman of PwC's results.



Appendix D

Public Sector Clients

Milliman’s experience performing actuarial services for large public employee retirement systems dates back to our engagement with the Washington State Employees Retirement System in 1947. The following representative list of our current PERS clients speaks to our ability to provide actuarial services to complex public retirement systems. We perform recurring services such as actuarial valuations and experience investigations for these systems, as well as asset/liability studies, projection models and other special studies.

- California State Teachers’ Retirement System
- Florida Retirement System
- Government of Guam Retirement Fund
- Idaho Public Employees Retirement System
- Los Angeles County Employees Retirement Association
- New Jersey Teachers’ Pension and Annuity Fund (*Philadelphia office leads*)
- New York City Metropolitan Transportation Authority (*Philadelphia office leads*)
- Oregon Public Employees Retirement System
- Puerto Rico Government Employees Retirement System (*Philadelphia office leads*)
- Puerto Rico Teachers Retirement System (*Philadelphia office leads*)
- San Mateo County Employees Retirement Association
- Santa Barbara County Employees Retirement System
- Seattle City Employees Retirement System
- Southeastern Pennsylvania Transportation Authority (*Philadelphia office leads*)
- Texas County and District Retirement System (*Philadelphia office assists*)

The following table lists the actuarial audits of public employee retirement systems performed by Milliman since 2002.

System	Year Audit Performed
Contra Costa County Employees’ Retirement Association	2014, 2008
State of Washington Pension Funding Council and LEOFF 2 Retirement Board	2014
City of Dallas Employees Retirement Fund	2013
Harris County Hospital District (Houston, Texas)	2013
Marin County Employees’ Retirement Association	2013
San Bernardino County Employees’ Retirement Association	2013, 2009
City and County of San Francisco Employees’ Retirement System	2013
University Health System (San Antonio, Texas)	2013
Orange County Employees’ Retirement System	2012
Marin County Employees’ Retirement Association	2012
San Diego County Employees Retirement Association	2012, 2008
United Nations Joint Staff Pension Fund	2012
Minnesota Legislative Commission on Pensions and Retirement (annual audit of 13 state pension funds)	2009 to current

System	Year Audit Performed
City of Aurora, Colorado	2009
Denver Water, Colorado	2009
Employees Retirement System of Texas	2009
Foreign Service Retirement and Disability Fund (US Department of State)	2009, 2008, 2007, 2006
Idaho Judges Retirement Fund	2009
Nebraska Department of Labor	2009
State Teachers Retirement System of Ohio	2009
Teacher Retirement System of Texas	2009
Wyoming Retirement System	2009, 2004
City of Phoenix Employees Retirement System	2008
District of Columbia Retirement System	2008
Lower Colorado River Authority (Austin, TX)	2008
Nebraska Public Employees Retirement System	2008
San Luis Obispo County Pension Trust	2008
Stanislaus County Employees' Retirement Association	2008
University Health System (San Antonio, TX)	2008
Alameda County Employees' Retirement Association	2007
Arizona Public Safety Personnel Retirement System	2007
Missouri Education Employees Retirement System	2007
Missouri Public Schools Retirement System	2007
New Mexico Retiree Health Care Authority	2007
State Teachers' Retirement System of Vermont	2007
Vermont Municipal Employees' Retirement System	2007
Vermont State Employees' Retirement System	2007
Pennsylvania Public School Employees Retirement System	2006, 2001
Wisconsin Retirement System	2006
Teacher Retirement System of Texas	2005, 2002
Pennsylvania State Employees' Retirement System	2005
Portland Fire and Police Disability and Retirement Fund	2005
Arizona State Retirement System	2004

System	Year Audit Performed
State of Washington Retirement Systems	2004, 2002
Texas Employees Retirement System	2004
City of Austin Employees Retirement System	2003
Retirement Systems of Alabama	2003
Alaska State Public Employee and Teacher Systems	2002
Dallas Employees Retirement Fund	2002
Indiana Public Employees Retirement Fund	2002
Kentucky Teachers Retirement System	2002
Texas Statewide Emergency Services Retirement Fund	2002